TEST REPORT

Your Ref:

Date: 30 Dec 2004

Our Ref: 56S040964/01

DID: +65-6885 1449

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NOTE: This report is issued subject to PSB Corporation's "Terms and Conditions Governing Technical Services". The terms and conditions governing the issue of this report are set out as attached within this report.

FORMAL REPORT ON TESTING IN ACCORDANCE WITH

FCC PARTS 15B & C : 2004
OF A
HANDHELD WinCE DEVICE WITH BLUETOOTH & 802.11b WLAN
[MODEL : R1018]
[FCC ID : RKS-R1018]

TEST FACILITY	Telecoms & EMC, Testing Group, PSB Corporation Pte Ltd 1 Science Park Drive, Singapore 118221
FCC REG. NO.	90937 (3m & 10m OATS) 99142 (10m Anechoic Chamber) 871638 (5m Anechoic Chamber)
IND. CANADA REG. NO.	IC 4257 (10m Anechoic Chamber)
PREPARED FOR	Mr Foong Foo Kong Olympus Technologies Singapore Pte Ltd 41 Science Park Road #04-10 The Germini Singapore Science park 2 Singapore 117610 Tel : (65) 6870 2541 Fax : (65) 6870 2508
JOB NUMBER	56S040964
TEST PERIOD	10 Dec 2004 – 30 Dec 2004

PREPARED BY	**APPROVED BY**
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LA-2001-0212-A
LA-2001-0213-F
LA-2001-0214-E
LA-2001-0215-B
LA-2001-0216-G
LA-2001-0217-G

The results reported herein have been performed in accordance with the laboratory's terms of accreditation under the Singapore Accreditation Council - Singapore Laboratory Accreditation Scheme

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The product was tested in accordance with the customer's specifications.

Test Results Summary

The following tests were tested when EUT was operating in Bluetooth test mode.

FCC Paragraphs	Descriptions	Pass / Fail
15.107, 15.207	Conducted Emissions	Pass
15.205	Radiated Emissions (Restricted Band Requirements)	Pass
15.109, 15.209	Radiated Emissions (Spurious Emissions)	Pass
15.247 (a)(1)	Carrier Frequency Separation	Pass
	Spectrum Bandwidth (20dB Bandwidth Measurement)	Pass
15.247 (a)(1)(iii)	Number of Hopping Frequencies	Pass
	Average Frequency Dwell Time	Pass
15.247 (b)(1)	Maximum Peak Power	Pass
15.247 (c)	RF Conducted Spurious Emissions & Band Edge Compliance at the Transmitter Antenna Terminal	Pass
15.247 (d)	Peak Power Spectral Density	Pass

Notes

1. Three channels as listed below, which respectively represent the lower, middle and upper channels of the equipment under test (EUT) were chosen and tested. For each channel, the EUT was configured to operate in the Bluetooth test mode

Transmit Channel	Frequency (GHz)
Channel 0	2.402
Channel 39	2.441
Channel 78	2.480

2. All the measurements in section 15.247 were done based on conducted measurements.

3. The EUT is a Class B device when in non-transmitting state and meets the FCC Part15B Class B requirements.

Modifications

No modifications were done.

The product was tested in accordance with the customer's specifications.

Test Results Summary

The following tests were tested when EUT was operating in 802.11b WLAN test mode.

FCC Paragraphs	Descriptions	Pass / Fail
15.107, 15.207	Conducted Emissions	Pass
15.205	Radiated Emissions (Restricted Band Requirements)	Pass
15.109, 15.209	Radiated Emissions (Spurious Emissions)	Pass
15.247 (d)	Peak Power Spectral Density	Pass
15.247 (a)(2)	Spectrum Bandwidth (6dB Bandwidth Measurement)	Pass
15.247 (b)(3)	Maximum Peak Power	Pass
15.247 (c)	RF Conducted Spurious Emissions & Band Edge Compliance at the Transmitter Antenna Terminal	Pass
15.247 (d)	Peak Power Spectral Density	Pass

Notes

1. The channels as listed below, under the different configurations were tested for 802.11b WLAN

Transmit Channel	Frequency (GHz)	Modulation	Data Rate
Channel 1	2.412	DBPSK	1Mbps
Channel 7	2.442	DBPSK	1Mbps
Channel 13	2.472	DBPSK	1Mbps
Channel 1	2.412	DQPSK	2Mbps
Channel 7	2.442	DQPSK	2Mbps
Channel 13	2.472	DQPSK	2Mbps
Channel 1	2.412	CCK	5.5Mbps
Channel 7	2.442	CCK	5.5Mbps
Channel 13	2.472	CCK	5.5Mbps
Channel 1	2.412	CCK	11Mbps
Channel 7	2.442	CCK	11Mbps
Channel 13	2.472	CCK	11Mbps

2. All the measurements in section 15.247 were done based on conducted measurements.

3. The EUT is a Class B device when in non-transmitting state and meets the FCC Part15B Class B requirements.

Modifications

No modifications were done.

Description	:	The Equipment Under Test (EUT) is **a Handheld WinCE device with Bluetooth and WLAN features**. The handheld device enables the users to have wireless transmission using Bluetooth or WLAN besides uses as a normal handheld PDA. **Note: Bluetooth and WLAN can co-transmitted at one time for the handheld device.**
Manufacturer	:	Olympus Technologies Singapore Pte Ltd
Model Number	:	R1018
FCC ID	:	RKS-R1018
Serial Number	:	256-009 (for RF conducted tests) A00009(for conducted and radiated spurious emissions tests)
Microprocessor	:	Motorola MX1-L200MHz
Operating / Transmitting Frequency	:	<u>Bluetooth</u> 2.402GHz to 2.480GHz 79 channels. Starting at 2.402MHz with subsequent channel at 1MHz interval from the preceding channel. <u>802.11b WLAN</u> 2.412GHz to 2.472GHz with 13 channels. Starting at 2.412MHz with subsequent channel at 5MHz interval from the preceding channel.
Clock / Oscillator Frequency	:	200MHz
Modulation	:	<u>Bluetooth</u> Gaussian Frequency Shift Keying (GFSK) with BT = 0.5 <u>802.11b WLAN</u> DBPSK @ 1Mbps DQPSK @ 2Mbps CCK @ 5.5Mbps CCK @ 11Mbps
Port / Connectors	:	1 x Cradle port
Rated Input Power	:	5V via AC/DC Power Adapter

SUPPORTING EQUIPMENT DESCRIPTION

The following equipment were used as supporting equipment during the tests.

Equipment Description (Including Brand Name)	**Model, Serial & FCC ID Number**	**Cable Description** (List Length, Type & Purpose)
Seiko Smart Label (For RE only)	M/N: SLP-220 S/N: B011331000 FCC ID: DoC	1.8m parallel cable.
Seiko Smart Label AC/DC Power Adapter (For RE only)	M/N: PW-4012-W1 S/N: 00009 FCC ID: Nil	1.8m unshielded AC power cable. 2.0m unshielded DC output cable.
Digital Keyboard (For RE only)	M/N: 120478-001 S/N: A2542416 FCC ID: AQ6-MTN56Z15	1.80m standard keyboard cable.
IBM Mouse (For RE only)	M/N: MO09K S/N: 23-203646 FCC ID: DoC	1.80m standard mouse cable.
Lemel Modem (For CE only)	M/N: MD-56K S/N: Nil FCC ID: DoC	1.8m DC output from power adapter with moulded ferrite clamp M/N: AA-121-A.
HP Keyboard (For CE only)	M/N: SK-2502C S/N: M010130277 FCC ID: DoC	1.80m standard keyboard cable.
ACER Mouse (For CE only)	M/N: M-UVACR1 S/N: LZC43902D43 FCC ID: DoC	1.80m standard mouse cable.
Compaq Notebook	M/N: Evo N800v S/N: KRD32401W1 FCC ID: DoC	Nil
Compaq Notebook AC/DC Power Adapter	M/N: 239427-001 S/N: 3410756104 FCC ID: Nil	1.8m unshielded AC power cable. 1.6m unshielded DC output cable.
Handheld WinCE Device (EUT)	M/N: R1018 S/N: 256-009 S/N: A00009 FCC ID: RKS-R1018	Cable Cup, M/N: Nil. 1.4m USB & Serial Sync Cable M/N: Nil.
EUT AC/DC Power Adapter	M/N: DSA-0101F-05A S/N: Nil FCC ID: Nil	1.9m unshielded DC output cable with moulded ferrite clamp.

EUT OPERATING CONDITIONS

The EUT was powered from 110V, 60Hz mains supply.

Tests	Description Of Operation (Bluetooth)
1. Conducted Emissions 2. Radiated Emissions 3. Carrier Frequency Separation 4. Spectrum Bandwidth (20dB Bandwidth Measurement) 5. Number of Hopping Frequencies 6. Average Frequency Dwell Time 7. Maximum Peak Power 8. RF Conducted Spurious Emissions at the Transmitter Antenna Terminal 9. Band Edge Compliance at the Transmitter Antenna Terminal 10. Peak Power Spectral Density	The EUT was exercised by operating in the Bluetooth test mode with maximum transmitting power and following configuration during the tests: <u>Carrier Frequency Separation, Number of Hopping Frequency, Average Frequency Dwell Time, Band Edge at the Transmitting Antenna:</u> Frequency hopping and modulation are on. <u>Conducted Emissions, Radiated Emissions, Spectrum Bandwidth (20dB Bandwidth Measurement), Maximum Peak Power, RF Conducted Spurious Emissions at the Transmitter Antenna Terminal and Peak Power Spectral Density</u> Frequency hopping is off and the modulation is on. Note: For all the tests mentioned above, the DH1 packet was used with the PRBS 9 as the payload.

EUT OPERATING CONDITIONS

The EUT was powered from 110V, 60Hz mains supply.

Tests	Description Of Operation (802.11b WLAN)
1. Conducted Emissions 2. Radiated Emissions 3. Spectrum Bandwidth (6dB Bandwidth Measurement) 4. Maximum Peak Power 5. RF Conducted Spurious Emissions at the Transmitter Antenna Terminal 6. Band Edge Compliance at the Transmitter Antenna Terminal 7. Peak Power Spectral Density	The EUT was exercised in test mode which enabled the EUT to be in continuous transmission with maximum power in following operating modes: EUT in continuous transmission in Channel 1, Channel 7 and Channel 13 respectively with transmission rate of 1Mbps, 2Mbps, 5.5Mbps and 11Mbps

FCC Part 15C (15.107 & 15.207) Conducted Emission Results

Operation Mode: Bluetooth

Frequency (MHz)	Q-P Value (dBμV)	Q-P Margin (dB)	AV Value (dBμV)	AV Margin (dB)	Line	Channel
0.1620	48.5	-16.8	43.4	-11.9	Neutral	78
0.1651	49.7	-15.5	46.4	-8.8	Live	78
0.3282	43.9	-15.5	39.4	-10.0	Live	39
0.8242	41.5	-14.5	35.5	-10.5	Live	78
1.1674	40.3	-15.7	33.5	-12.5	Neutral	78
1.6494	42.2	-13.8	33.3	-12.7	Live	78

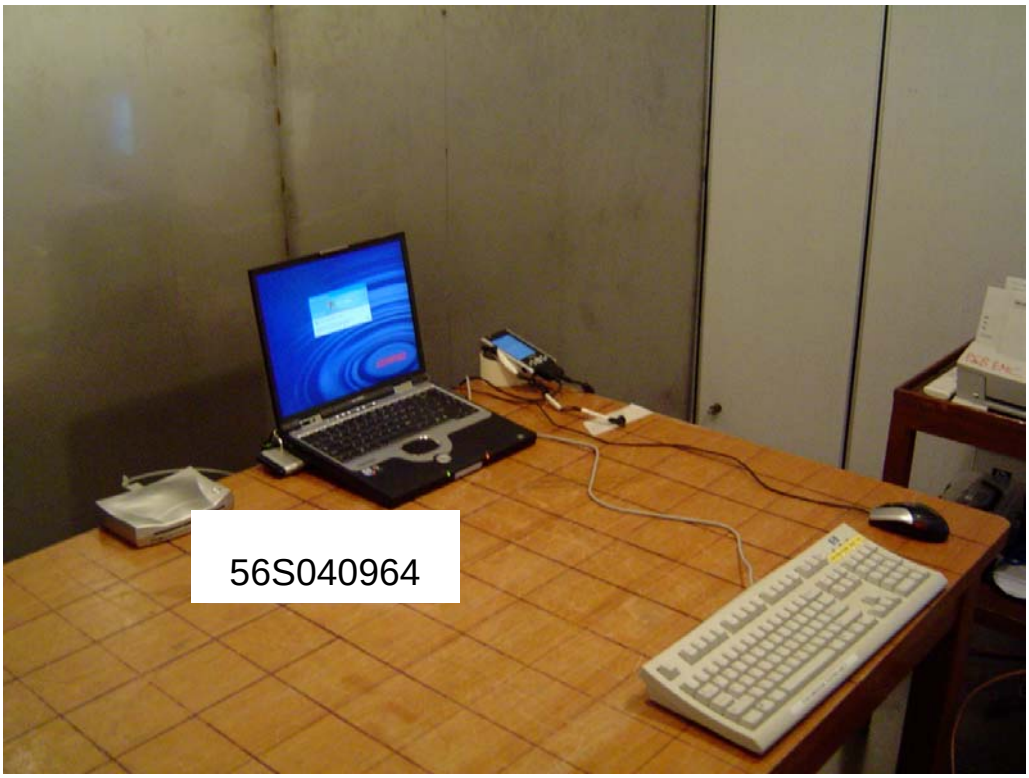
Operation Mode: 802.11b WLAN

Frequency (MHz)	Q-P Value (dBμV)	Q-P Margin (dB)	AV Value (dBμV)	AV Margin (dB)	Line	Channel
0.1866	47.2	-16.9	41.1	-13.0	Live	13
0.1874	46.1	-18.0	39.2	-14.9	Neutral	13
0.4532	39.5	-17.3	32.2	-14.6	Live	13
3.7432	41.3	-14.7	31.4	-14.6	Live	7
23.9330	41.0	-19.0	37.2	-12.8	Live	13
24.0650	42.3	-17.7	37.8	-12.2	Neutral	13

Tested by: TSS

Notes

1. All possible modes of operation were investigated from 150kHz to 30MHz. Only the 6 worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
3. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   9kHz - 30MHz
   RBW: 10kHz VBW: 30kHz
4. Conducted Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 9kHz – 30MHz (Average & Quasi-peak) is ±2.4dB.
5. The EUT was investigated for both co-transmission and individual transmission. The worst case transmission was selected for test.



Conducted Emissions Setup (Front View)

Conducted Emissions Setup (Rear View)

FCC Part 15C (15.109 & 15.209) Radiated Emission (Spurious Emissions) Results

Test Distance : 3m

Operation Mode: Bluetooth

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBμV/m)	Q-P Margin (dB)	Channel	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)
95.9691	33.9	-9.6	78	256	134	V
161.9798	40.9	-2.6	78	233	100	V
215.9628	34.3	-9.2	39	142	101	H
288.0026	36.9	-9.1	78	233	100	H
350.9732	41.6	-4.4	78	300	100	H
479.9377	34.3	-11.7	0	206	101	V

Spurious Emissions above 1GHz

Frequency (GHz)	Peak Value (dBμV/m)	Average Value (dBμV/m)	Average Margin (dB) See Note 3	Channel	Azimuth (Degrees)	Height (cm)	Pol (H/V)
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Tested by: JT

Notes

1. All possible modes of operation were investigated from 30MHz to 25GHz. All other emissions were relatively insignificant.
2. As the measured peak shows compliance to the average limit, as such no average measurement was required.
3. The average margin indicates the margin of the measured peak value below the average limit.
4. "--" indicates no emissions were found and shows compliance to the limits as specified in section 15.209. The emissions were merely the noise floor.
5. Quasi-peak measurement was used for frequency measurement up to 1GHz. Average and peak measurements were used for emissions above 1GHz. The average measurement was done by averaging over a complete cycle of the pulse train, including the blanking interval as the pulse train duration does not exceed 0.1 second.
6. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
7. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   30MHz - 1GHz
   RBW: 120kHz VBW: 1MHz
   >1GHz
   RBW: 1MHz VBW: 1MHz

8. The peak emissions above 1GHz show compliance to the requirement stated in Section 15.35 (b).
9. Radiated Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 30MHz – 25GHz (QP only @ 3m & 10m) is ±4.3dB (for EUTs < 0.5m X 0.5m X 0.5m).
10. The EUT was investigated for both co-transmission and individual transmission. The worst case transmission was selected for test.

FCC Part 15C (15.205) Radiated Emissions (Restricted Band Requirements) Results

Test Distance : 3m

Operation Mode: Bluetooth

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBμV/m)	Q-P Margin (dB)	Channel	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)
38.0979	26.1	-13.9	39	170	101	V
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Spurious Emissions above 1GHz (Bluetooth Mode)

Frequency (GHz)	Peak Value (dBμV/m)	Average Value (dBμV/m)	Average Margin (dB) See Note 3	Channel	Azimuth (Degrees)	Height (cm)	Pol (H/V)
1.4496	40.0	See Note 2	-14.0	78	309	100	H
1.7189	42.2	See Note 2	-11.6	78	288	101	H
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Tested by: JT

Notes

1. All possible modes of operation were investigated from 30MHz to 25GHz. All other emissions were relatively insignificant.
2. As the measured peak shows compliance to the average limit, as such no average measurement was required.
3. The average margin indicates the margin of the measured peak value below the average limit.
4. "--" indicates no emissions were found and shows compliance to the limits as specified in section 15.209. The emissions were merely the noise floor.
5. Quasi-peak measurement was used for frequency measurement up to 1GHz. Average and peak measurements were used for emissions above 1GHz. The average measurement was done by averaging over a complete cycle of the pulse train, including the blanking interval as the pulse train duration does not exceed 0.1 second.
6. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
7. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   30MHz - 1GHz
   RBW: 120kHz VBW: 1MHz
   >1GHz
   RBW: 1MHz VBW: 1MHz

8. The peak emissions above 1GHz show compliance to the requirement stated in Section 15.35 (b).
9. Radiated Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 30MHz – 25GHz (QP only @ 3m & 10m) is ±4.3dB (for EUTs < 0.5m X 0.5m X 0.5m).
10. The EUT was investigated for both co-transmission and individual transmission. The worst case transmission was selected for test.

FCC Part 15C (15.109 & 15.209) Radiated Emission (Spurious Emissions) Results

Test Distance : 3m

Operation Mode: 802.11b WLAN

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBμV/m)	Q-P Margin (dB)	Channel	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)
39.6614	30.3	-9.7	13 @ 11Mbps CCK	73	100	V
97.6295	37.3	-5.7	13 @ 11Mbps CCK	240	125	V
203.9044	39.9	-3.1	7 @ 11Mbps CCK	52	107	V
352.6892	40.9	-5.1	13 @ 11Mbps CCK	167	100	V
578.7650	37.9	-8.1	7 @ 11Mbps CCK	47	121	H
802.9183	35.3	-10.7	13 @ 11Mbps CCK	235	142	H

Spurious Emissions above 1GHz

Frequency (GHz)	Peak Value (dBμV/m)	Average Value (dBμV/m)	Average Margin (dB) See Note 3	Channel	Azimuth (Degrees)	Height (cm)	Pol (H/V)
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Tested by: JT

Notes

1. All possible modes of operation were investigated from 30MHz to 25GHz. All other emissions were relatively insignificant.
2. As the measured peak shows compliance to the average limit, as such no average measurement was required.
3. The average margin indicates the margin of the measured peak value below the average limit.
4. "--" indicates no emissions were found and shows compliance to the limits as specified in section 15.209. The emissions were merely the noise floor.
5. Quasi-peak measurement was used for frequency measurement up to 1GHz. Average and peak measurements were used for emissions above 1GHz. The average measurement was done by averaging over a complete cycle of the pulse train, including the blanking interval as the pulse train duration does not exceed 0.1 second.
6. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
7. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   30MHz - 1GHz
   RBW: 120kHz VBW: 1MHz
   >1GHz
   RBW: 1MHz VBW: 1MHz
8. The peak emissions above 1GHz show compliance to the requirement stated in Section 15.35 (b).
9. Radiated Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 30MHz – 25GHz (QP only @ 3m & 10m) is ±4.3dB (for EUTs < 0.5m X 0.5m X 0.5m).
10. The EUT was investigated for both co-transmission and individual transmission. The worst case transmission was selected for test.

FCC Part 15C (15.205) Radiated Emissions (Restricted Band Requirements) Results

Test Distance : 3m

Operation Mode: 802.11b WLAN

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBμV/m)	Q-P Margin (dB)	Channel	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)
163.3267	38.1	-4.9	13 @ 11Mbps CCK	53	100	V
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Spurious Emissions above 1GHz (802.11b WLAN)

Frequency (GHz)	Peak Value (dBμV/m)	Average Value (dBμV/m)	Average Margin (dB) See Note 3	Channel	Azimuth (Degrees)	Height (cm)	Pol (H/V)
1.1345	38.7	See Note 2	-15.3	13 @ 11Mbps CCK	256	127	H
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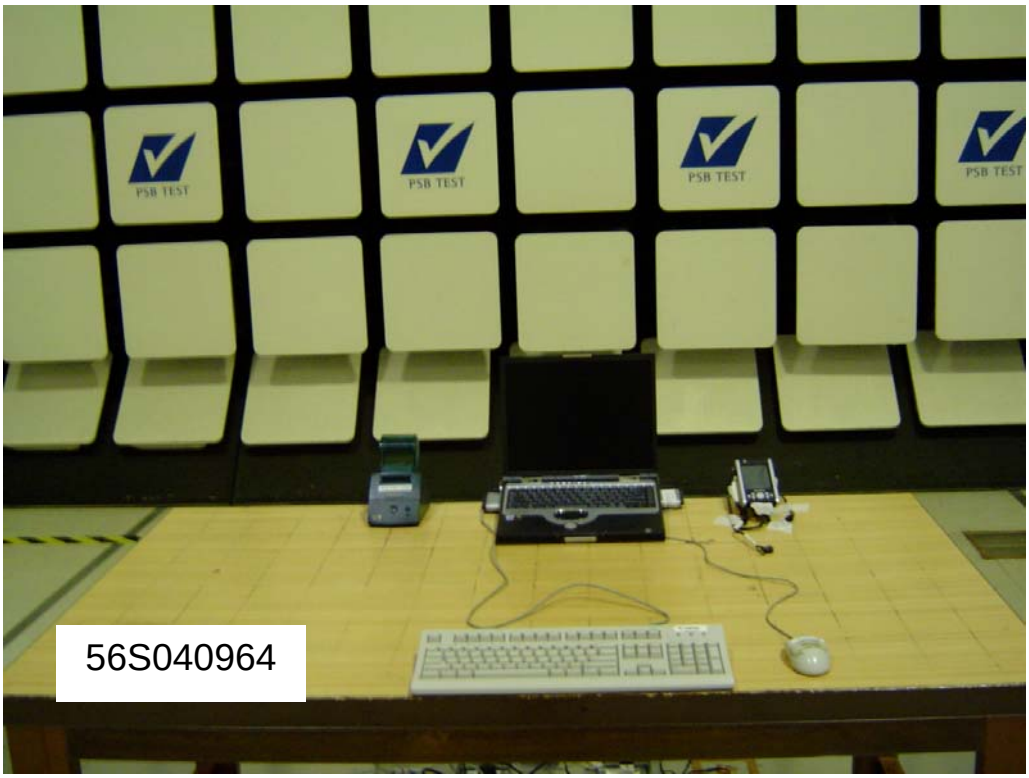
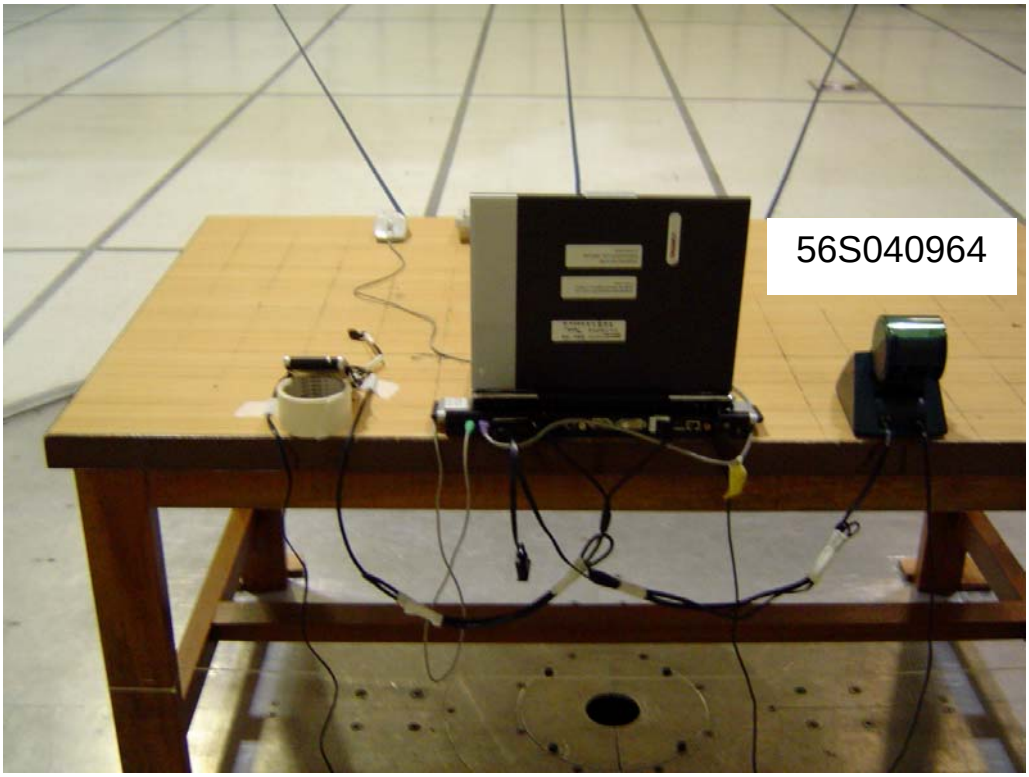
Tested by: JT

Notes

1. All possible modes of operation were investigated from 30MHz to 25GHz. All other emissions were relatively insignificant.
2. As the measured peak shows compliance to the average limit, as such no average measurement was required.
3. The average margin indicates the margin of the measured peak value below the average limit.
4. "--" indicates no emissions were found and shows compliance to the limits as specified in section 15.209. The emissions were merely the noise floor.
5. Quasi-peak measurement was used for frequency measurement up to 1GHz. Average and peak measurements were used for emissions above 1GHz. The average measurement was done by averaging over a complete cycle of the pulse train, including the blanking interval as the pulse train duration does not exceed 0.1 second.
6. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
7. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   30MHz - 1GHz
   RBW: 120kHz VBW: 1MHz
   >1GHz
   RBW: 1MHz VBW: 1MHz
8. The peak emissions above 1GHz show compliance to the requirement stated in Section 15.35 (b).
9. Radiated Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 30MHz – 25GHz (QP only @ 3m & 10m) is ±4.3dB (for EUTs < 0.5m X 0.5m X 0.5m).
10. The EUT was investigated for both co-transmission and individual transmission. The worst case transmission was selected for test.



Radiated Emissions Setup (Front View)



Radiated Emissions Setup (Rear View)

FCC Part 15C (15.247(a)(1)) Carrier Frequency Separation Results

Operation Mode: Bluetooth

The EUT shows compliance to the requirements of this section, which states the adjacent carrier frequencies must be separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

Adjacent Channels	Channel Separation (MHz)
0 and 1 (2.402GHz and 2.403GHz)	1.040
38 and 39 (2.440GHz and 2.441GHz)	1.025
39 and 40 (2.441GHz and 2.442GHz)	1.020
77 and 78 (2.479GHz and 2.480GHz)	1.025

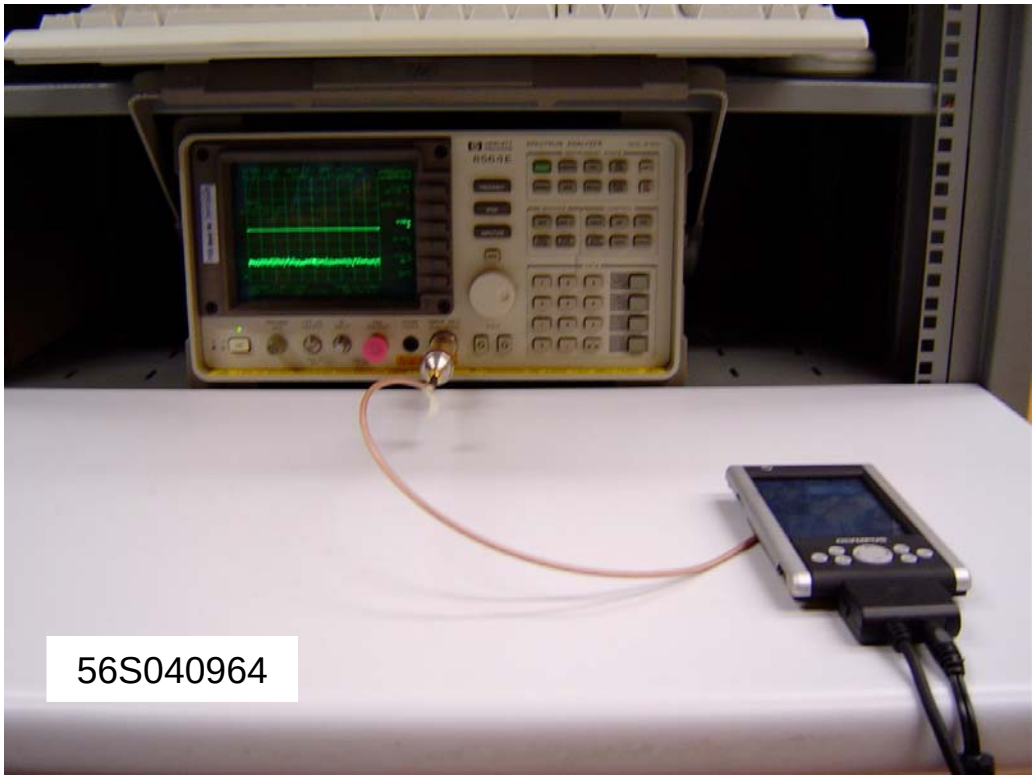
Please refer to the attached Plots 1 - 4 for details.

Tested by: DP

Notes

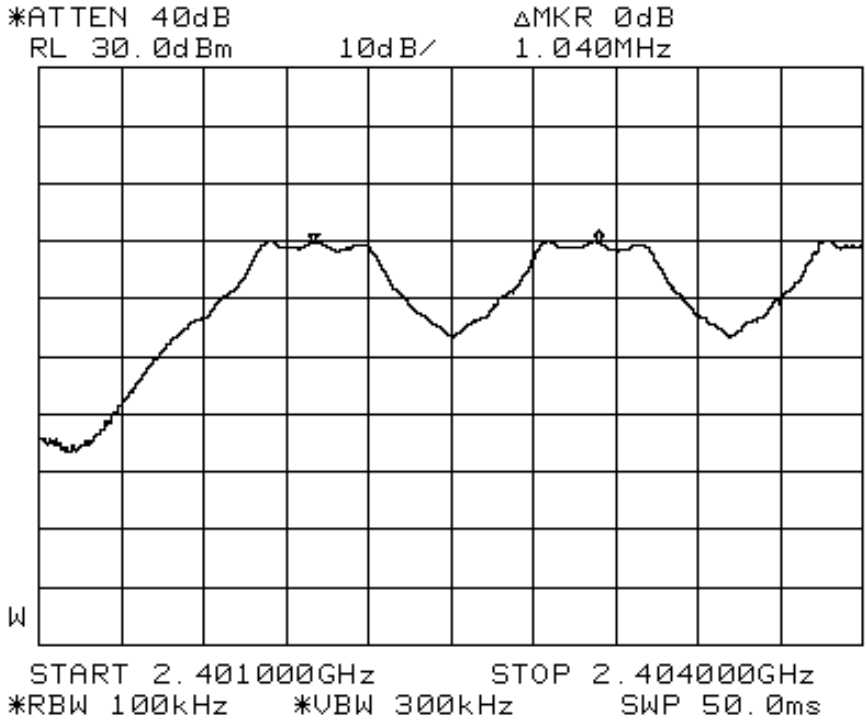
1. Environmental Conditions

Temperature	23°C
Relative Humidity	58%
Atmospheric Pressure	1030mbar

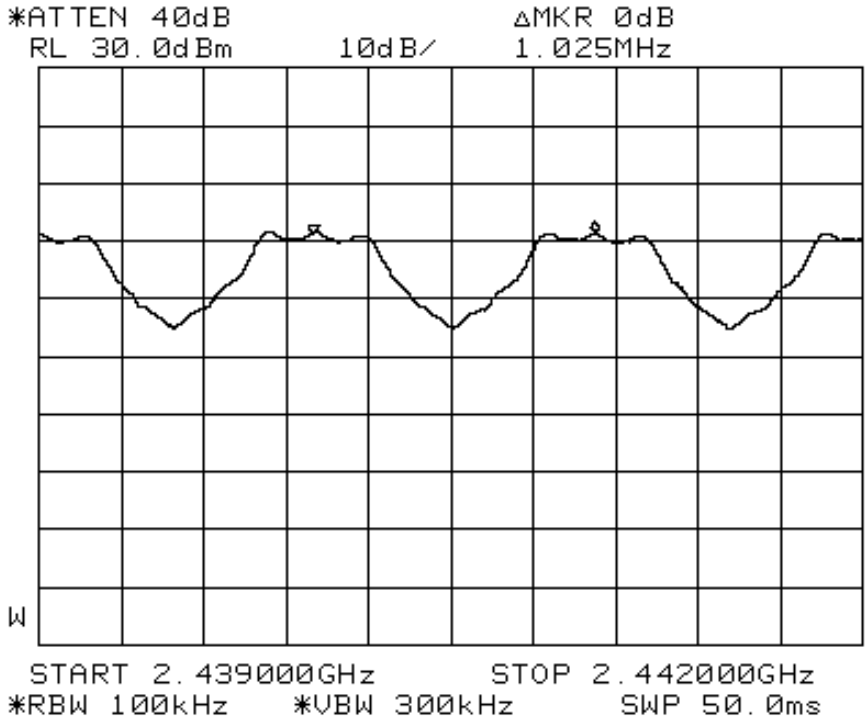


Carrier Frequency Separation Measurement Test Setup

CARRIER FREQUENCY SEPARATION PLOTS

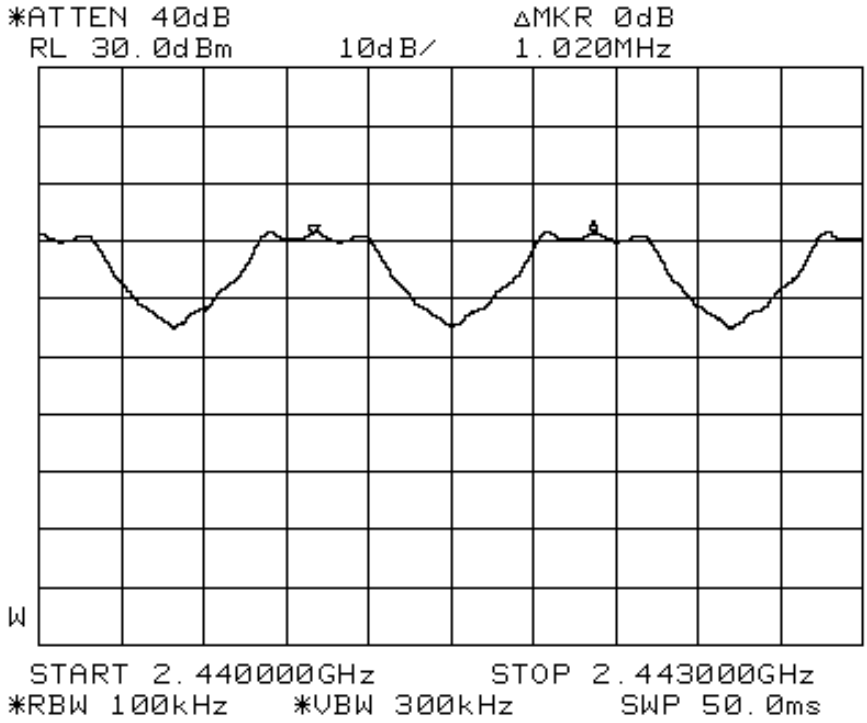


Plot 1- Channels 0 and 1 Separation

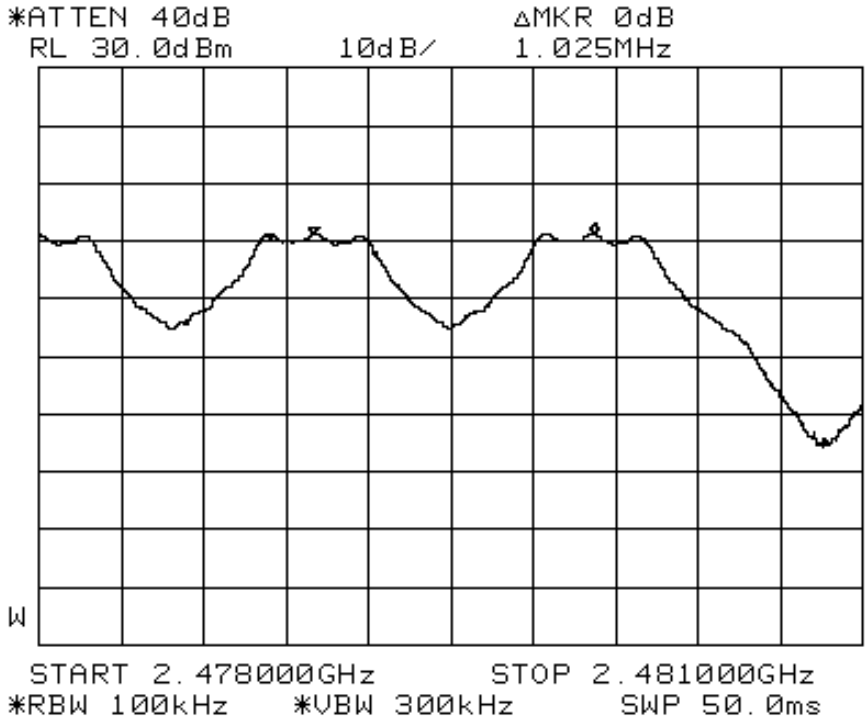


Plot 2 – Channels 38 and 39 Separation

CARRIER FREQUENCY SEPARATION PLOTS



Plot 3 - Channel 39 & 40 Separation



Plot 4 - Channel 77 and 78 Separation

FCC Part 15C (15.247(a)(1)) Spectrum Bandwidth (20dB Bandwidth Measurement) Results

Operation Mode: Bluetooth

The EUT shows compliance to the requirements of this section, which states that the 20dB bandwidth of the hopping channel shall be the channel frequency separation by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

Channel	Channel Frequency (GHz)	20dB Bandwidth (MHz)
0	2.402	0.720
39	2.441	0.720
78	2.480	0.730

Note: The EUT is a Bluetooth device, which supports no overlapping for each channel.

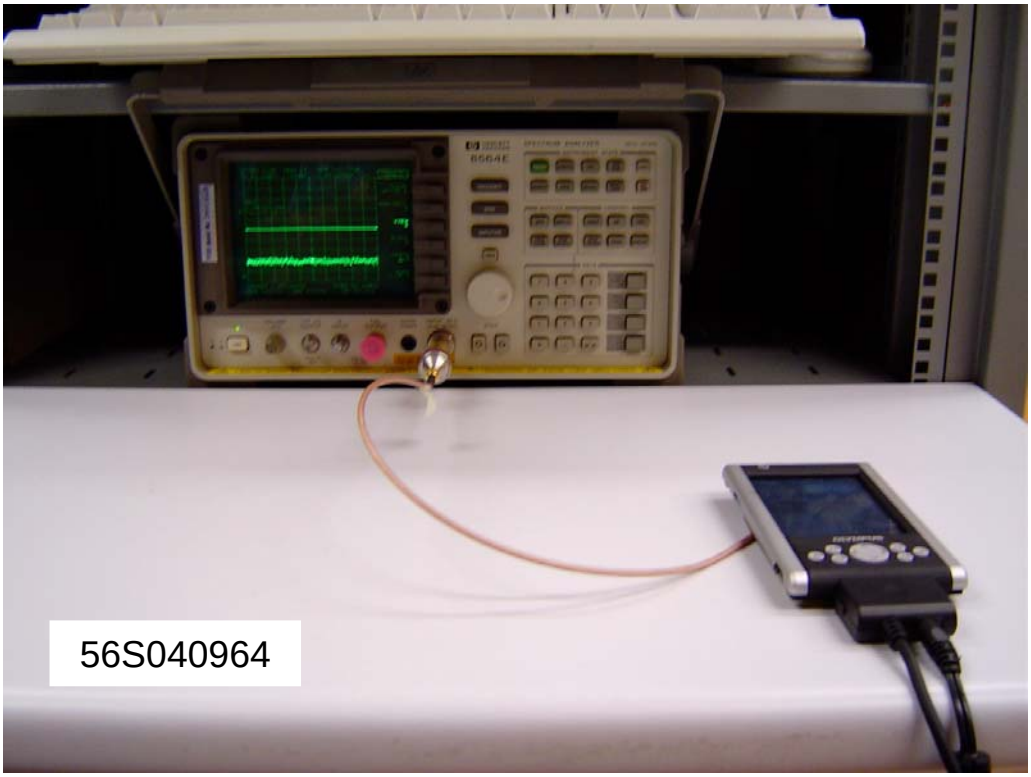
Please refer to attached Plots 5 - 7 for details.

Tested by: DP

Notes

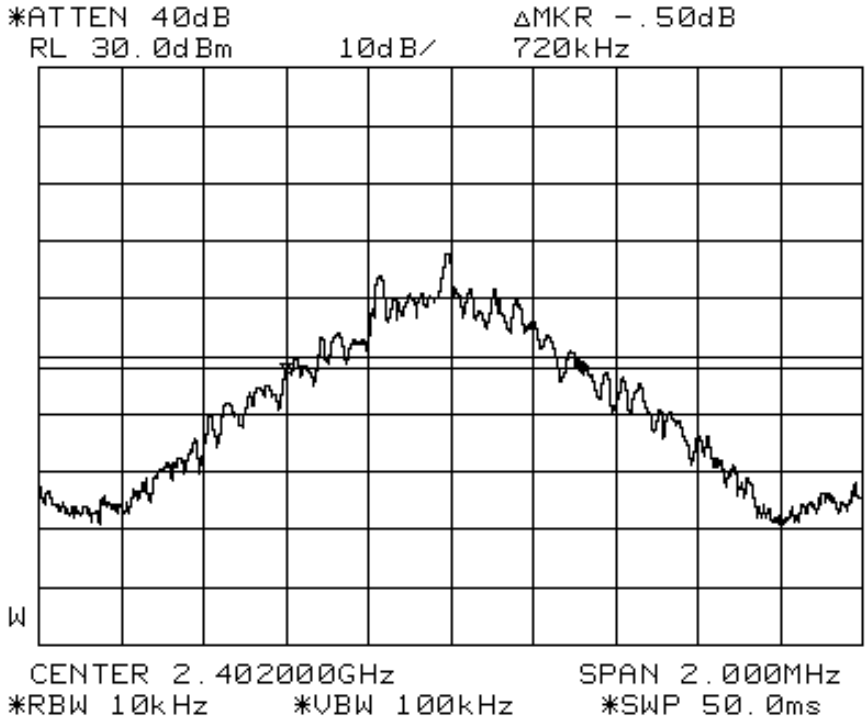
1. Environmental Conditions

Temperature	23°C
Relative Humidity	58%
Atmospheric Pressure	1030mbar

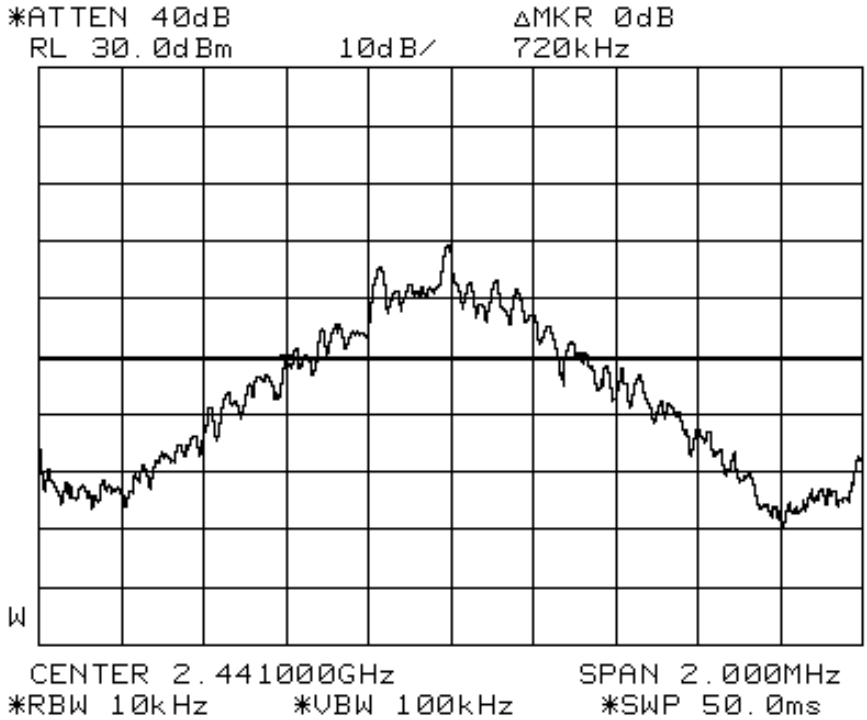


Spectrum Bandwidth Measurement Test Setup

SPECTRUM BANDWIDTH (20DB BANDWIDTH MEASUREMENT) PLOTS

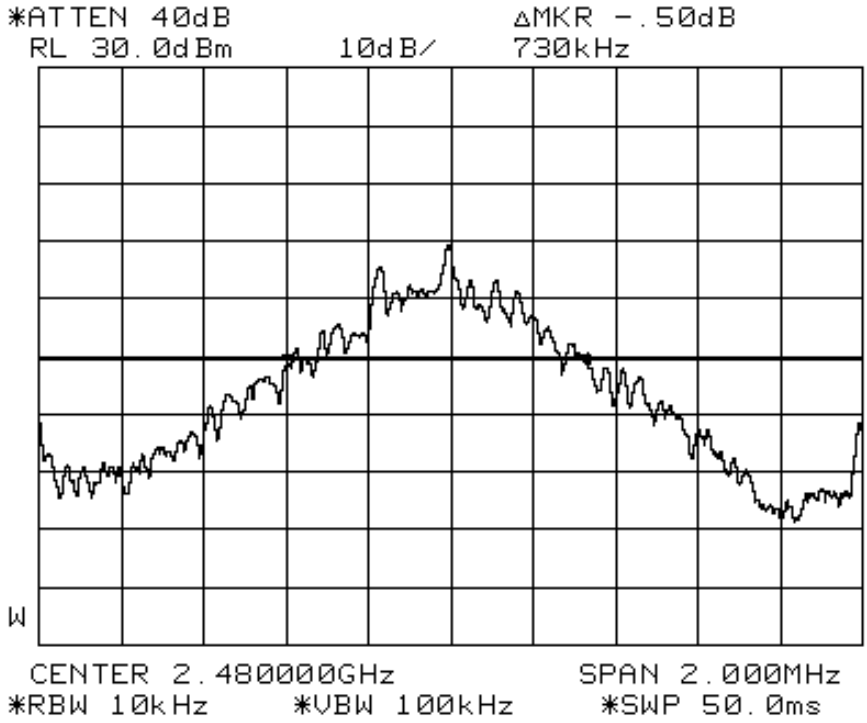


Plot 5 – Channel 0



Plot 6 – Channel 39

SPECTRUM BANDWIDTH (20DB BANDWIDTH MEASUREMENT) PLOTS



Plot 7 – Channel 78

FCC Part 15C (15.247(a)(1)(iii)) Number of Hopping Frequencies Results

Operation Mode: Bluetooth

The EUT shows compliance to the requirements of this section, which states the number of hopping frequencies shall be at least 75.

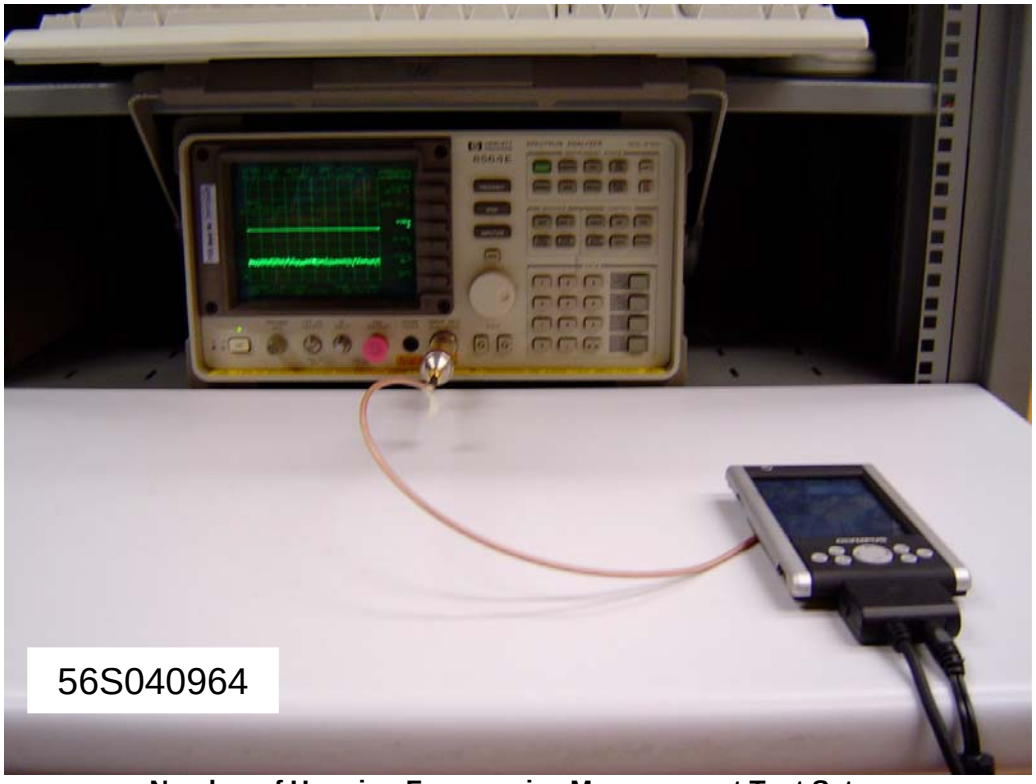
The EUT was found to have 79 hopping frequencies.

Please refer to the attached Plots 8 - 11 for details.

Tested by: DP

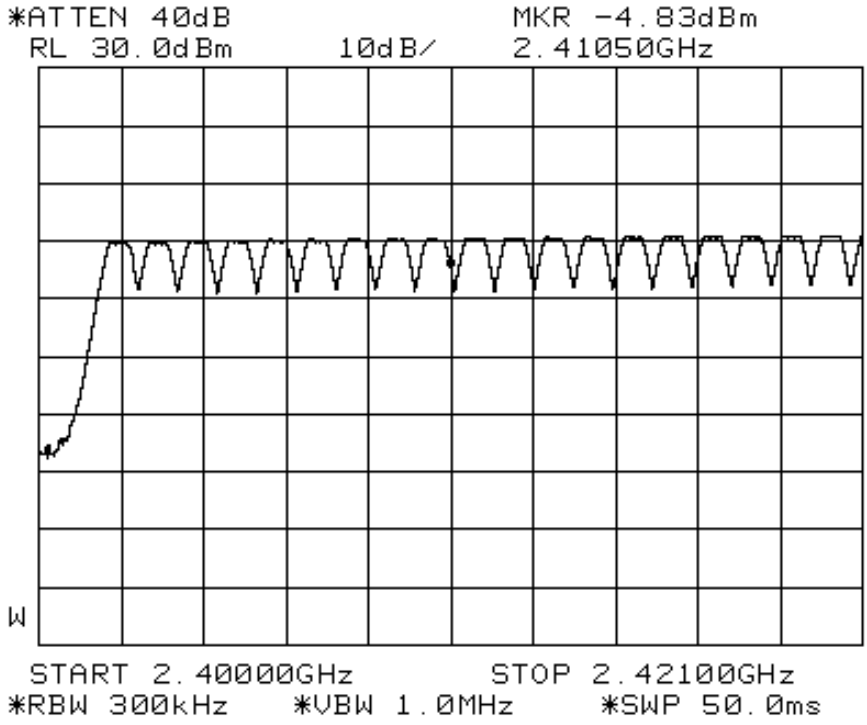
Notes

1.	Environmental Conditions	Temperature	23°C
		Relative Humidity	58%
		Atmospheric Pressure	1030mbar

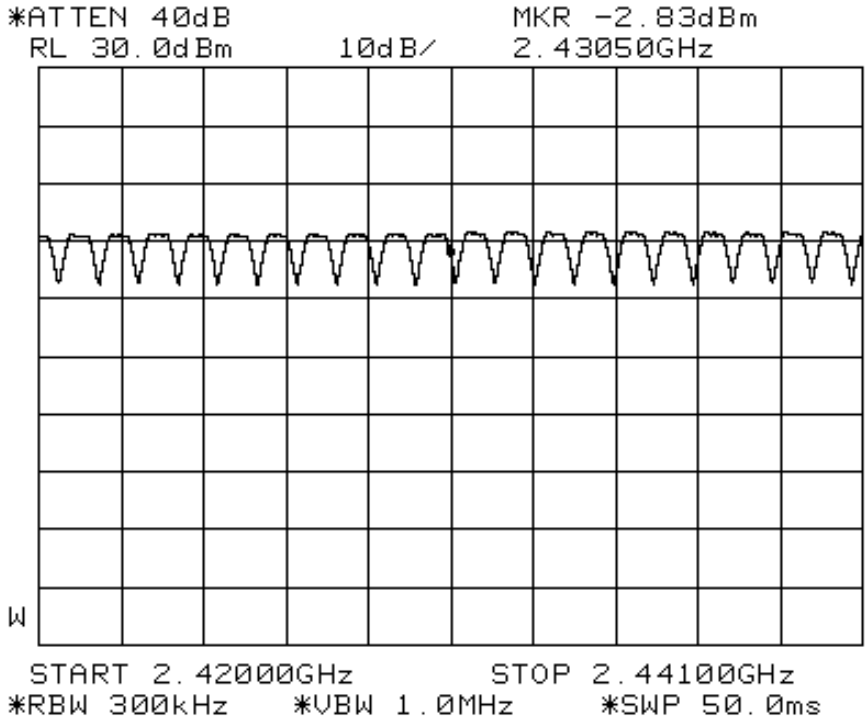


Number of Hopping Frequencies Measurement Test Setup

NUMBER OF HOPPING FREQUENCIES PLOTS

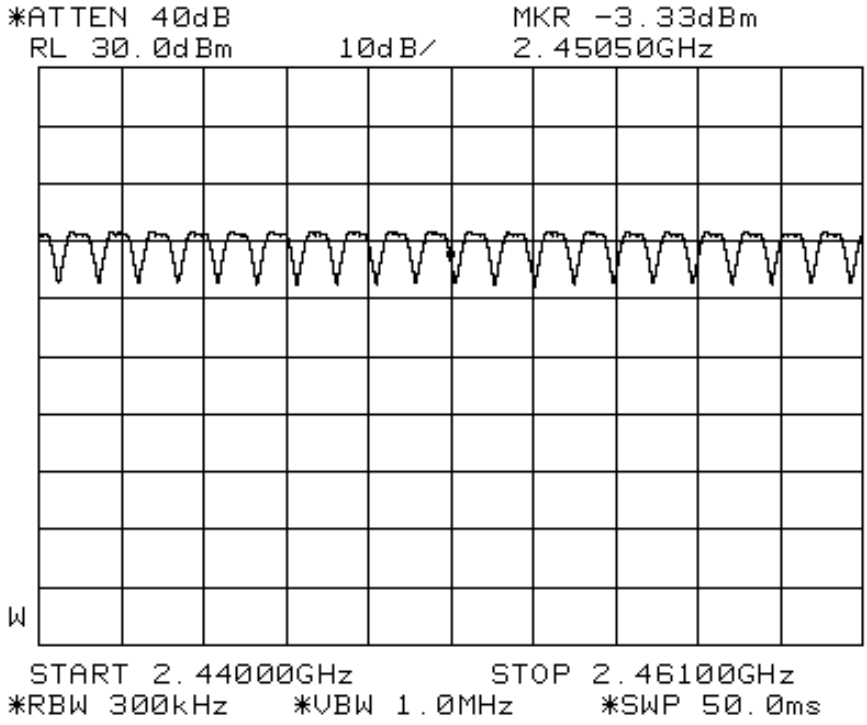


Plot 8 - Channels 0 to 18

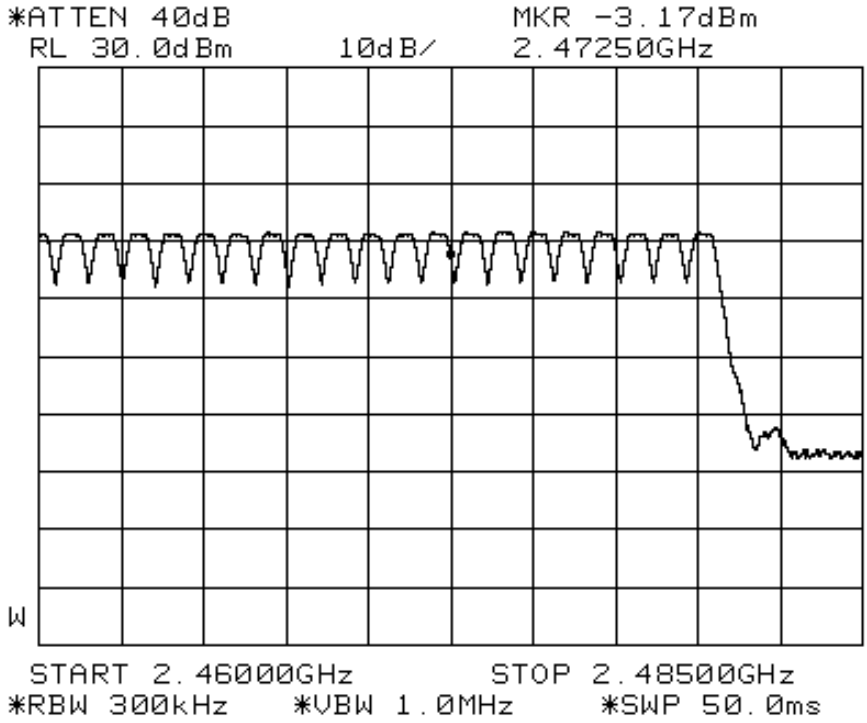


Plot 9 - Channels 19 to 38

NUMBER OF HOPPING FREQUENCIES PLOTS



Plot 10 - Channels 39 to 58



Plot 11 - Channels 59 to 78

FCC Part 15C (15.247(a)(1)(iii)) Average Frequency Dwell Time Results

Operation Mode: Bluetooth

The EUT shows compliance to the requirements of this section, which states the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a period of 0.4second multiplied by the number of hopping channels employed.

EUT hopping rate = 1600 hops/data packet length/s
Number of EUT hopping frequencies = 79 hops
DH1 packet was used as a transmission packet

Average Frequency Dwell Time = measured time slot length (l) x hopping rate (h) / number of hopping frequencies x 30 seconds period

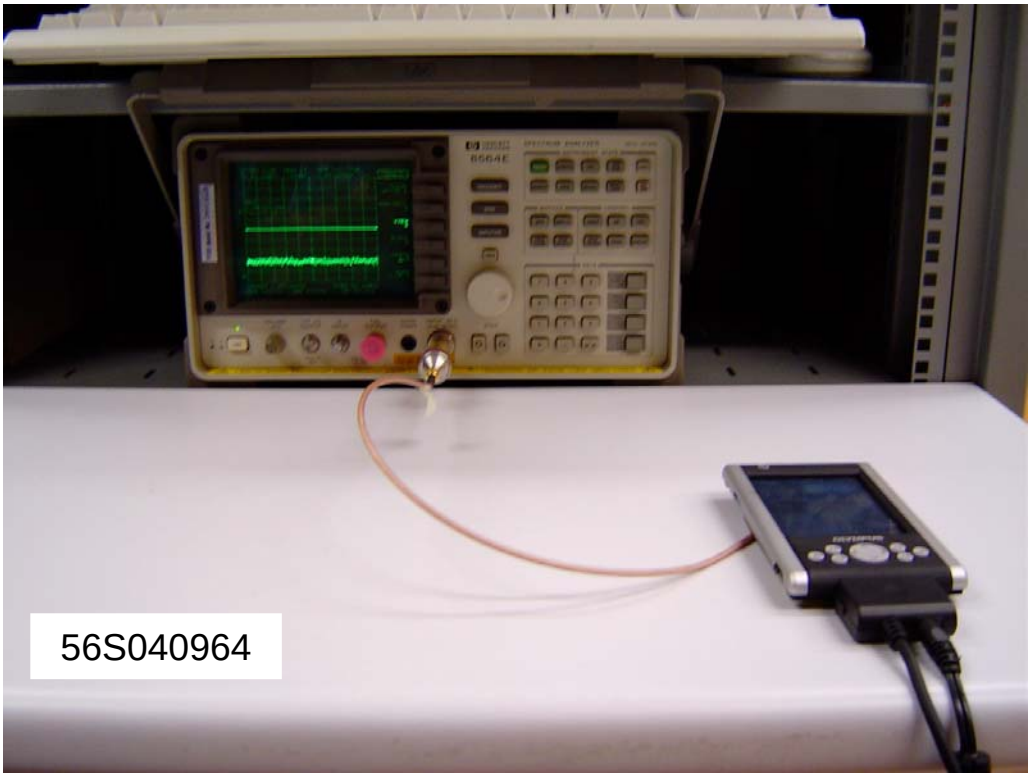
Channel	Channel Frequency (GHz)	Measured Time Slot Length for DH5 Packet (ms)	Average Frequency Dwell Time (s)	Average Occupancy Limit (s)
0	2.402	0.625	0.3798	0.4
39	2.441	0.625	0.3798	0.4
78	2.480	0.625	0.3798	0.4

Please refer to the attached Plots 12 – 14 for details.

Tested by: DP
Notes

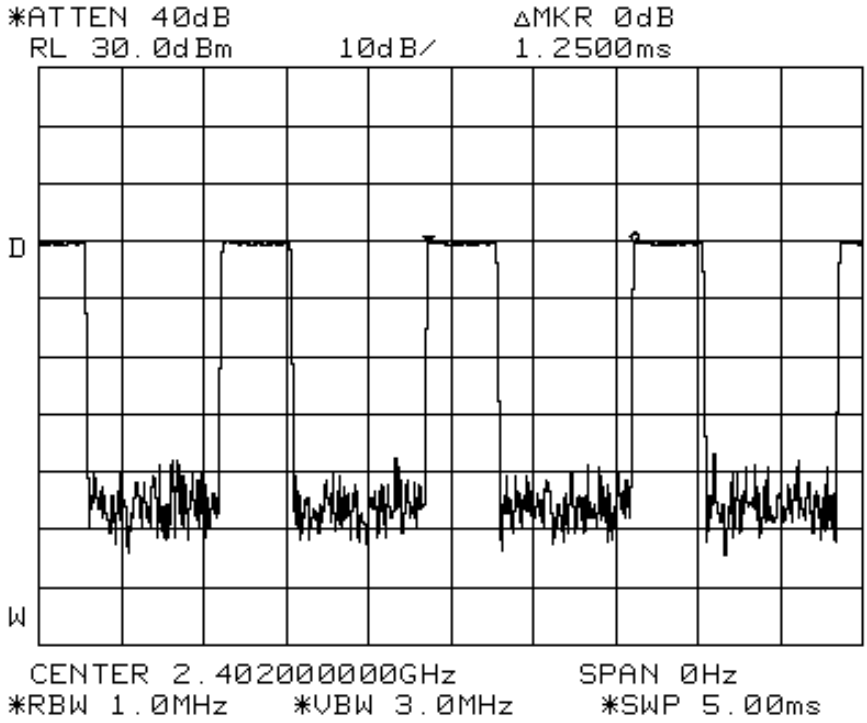
1. Environmental Conditions

Temperature	23°C
Relative Humidity	58%
Atmospheric Pressure	1030mbar

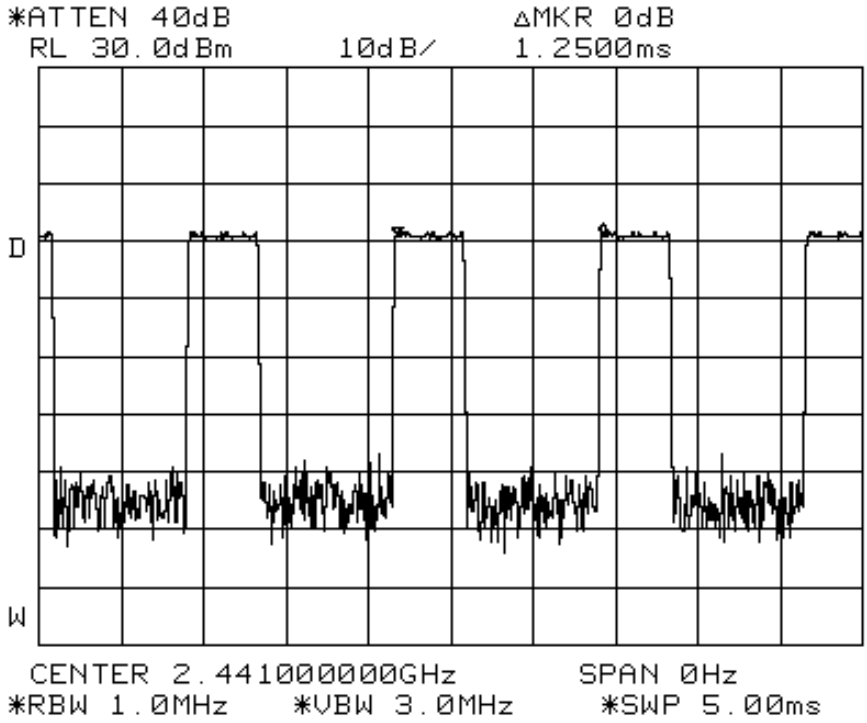


Average Frequency Dwell Time Measurement Test Setup

AVERAGE FREQUENCY DWELL TIME PLOTS

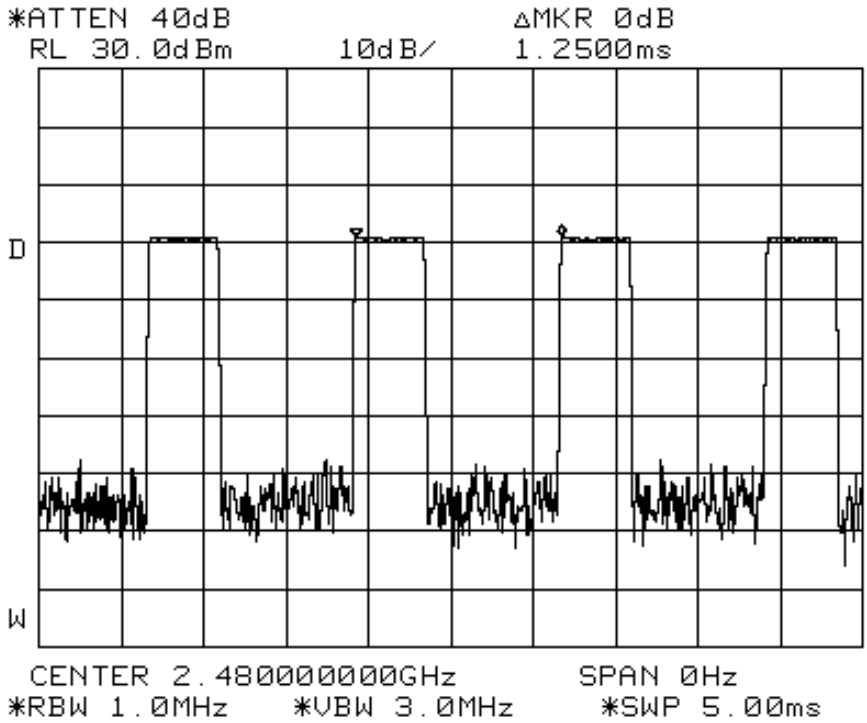


Plot 12 – Channel 0



Plot 13 – Channel 39

AVERAGE FREQUENCY DWELL TIME PLOTS



Plot 14 – Channel 78

FCC Part 15C (15.247(b)(1)) Maximum Peak Power Results

Operation Mode: Bluetooth

The EUT shows compliance to the requirements of this section, which states the peak power of an intentional radiator (EUT) shall not exceed 30dBm (1 Watt).

The maximum peak power for Channels 0, 39 and 78 at 2.402GHz, 2.441GHz and 2.480GHz respectively were investigated and found below 30dBm (1Watt).

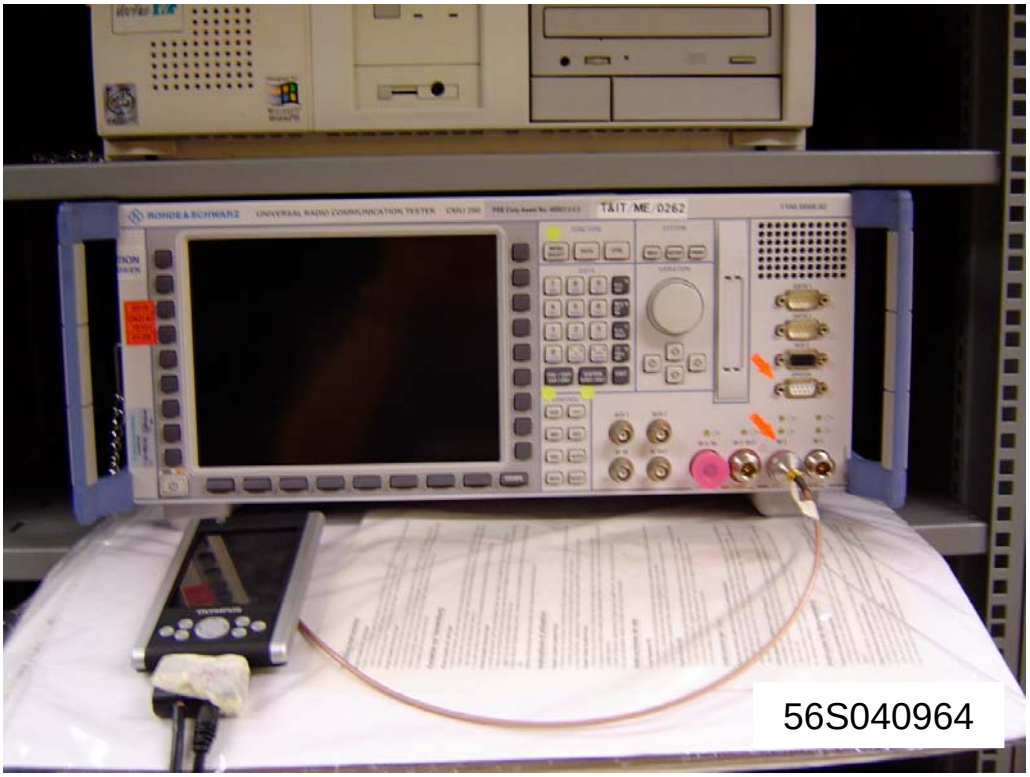
Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
0	2.402	0.001307	1
39	2.441	0.001973	1
78	2.480	0.002229	1

Tested by: DP

Notes

1. Environmental Conditions — Temperature: 23°C; Relative Humidity: 58%; Atmospheric Pressure: 1030mbar

2. Power analyser of Universal Radio Communication Tester was used for power measurement with peak detection as mode of measurement. The power analyser mode supports a wideband power measurement ranging from 100kHz to 2700MHz.



Maximum Peak Power Measurement Test Setup

FCC Part 15C (15.247(c)) RF Conducted Spurious Emissions & Band Edge Compliance at the Transmitter Antenna Results

Operation Mode: Bluetooth

The EUT shows compliance to the requirements of this section, which states in any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator (EUT) is operating, the RF power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power.

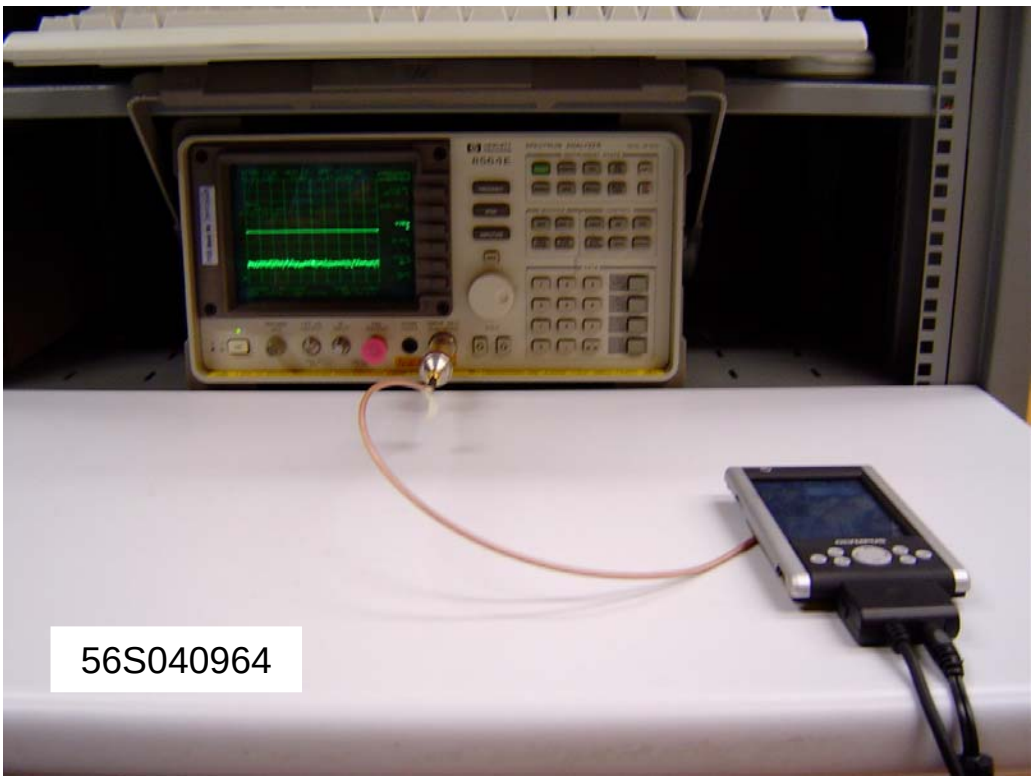
The RF conducted spurious emissions were scanned from 30MHz to 25GHz for Channels 0, 39, and 78 with channel frequency at 2.402GHz, 2.441GHz and 2.480GHz respectively. No significant signal was found and they were below the specified limit. Please refer to the attached Plots 15 – 20 for details.

The conducted spurious at lower and upper band-edges (2.4000GHz and 2.4835GHz) were scanned. The spurious emissions at band-edges were found below the specified limit. Please refer to the attached Plots 21 – 22 for details.

Tested by: DP

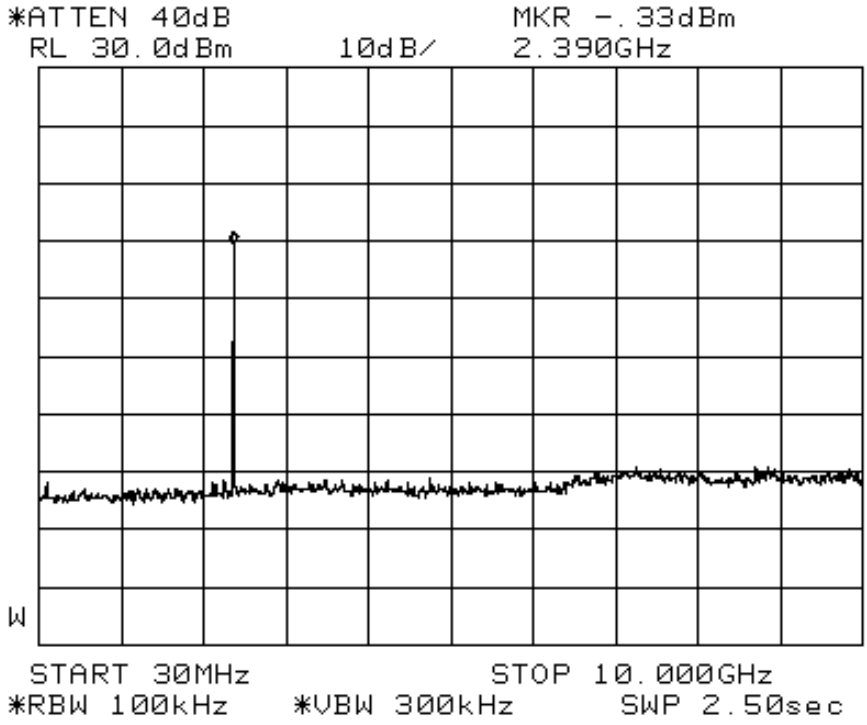
Notes

1.	Environmental Conditions	Temperature	23°C
		Relative Humidity	58%
		Atmospheric Pressure	1030mbar

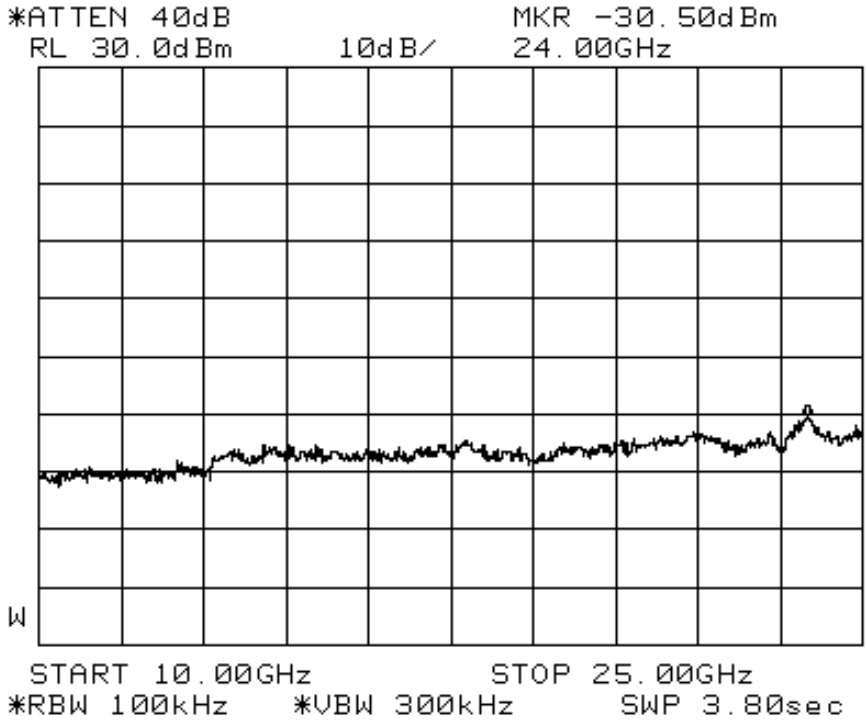


RF Conducted Spurious & Band Edge Measurement Test Setup

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

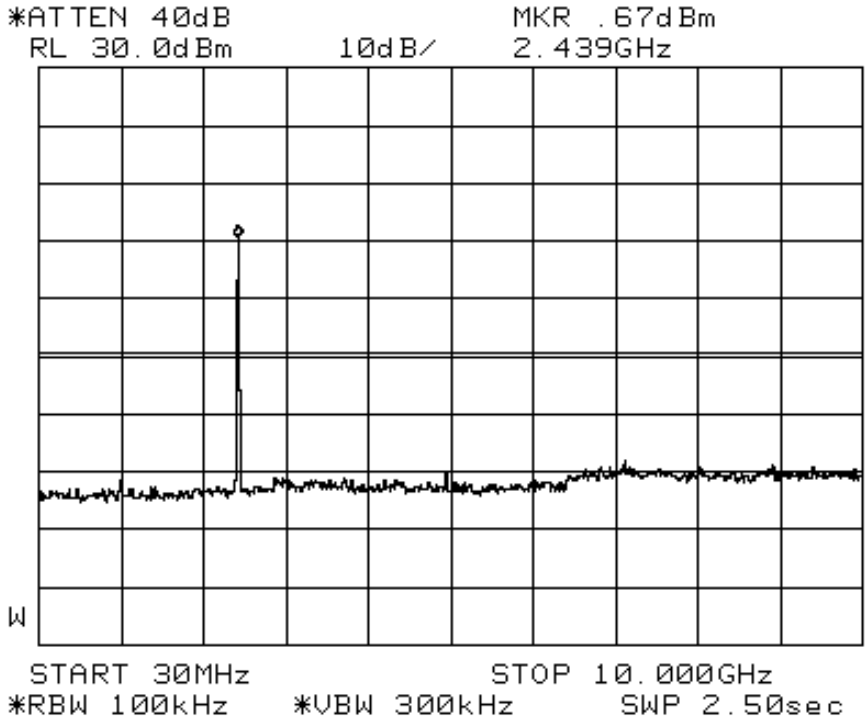


Plot 15 – Channel 0

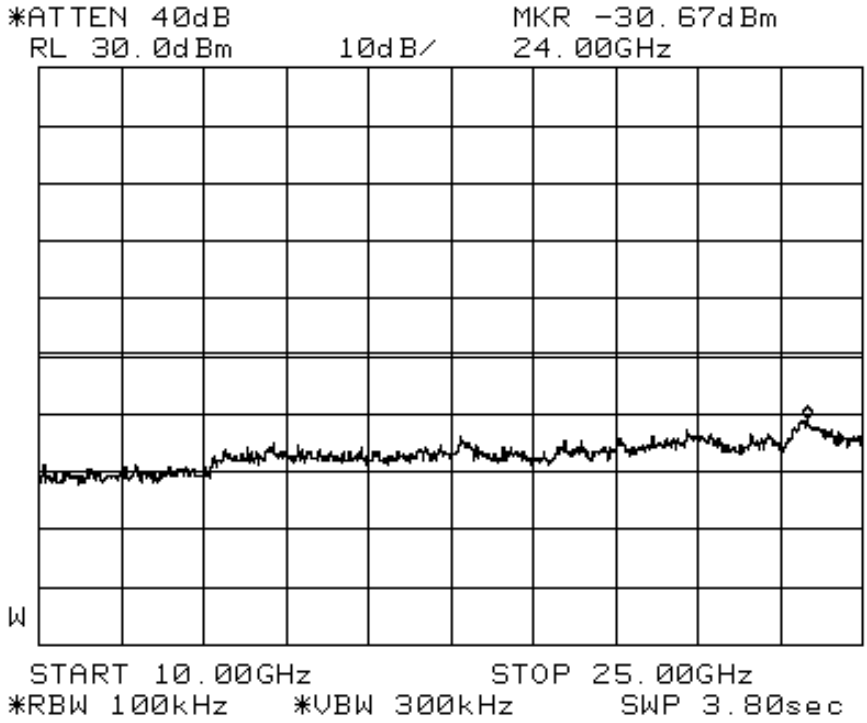


Plot 16 – Channel 0

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

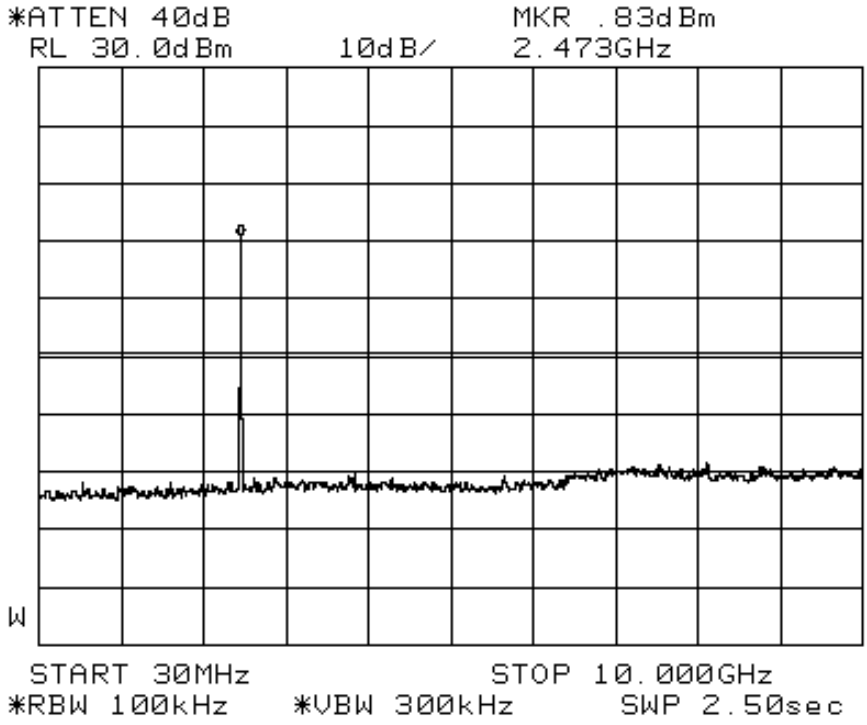


Plot 17 – Channel 39

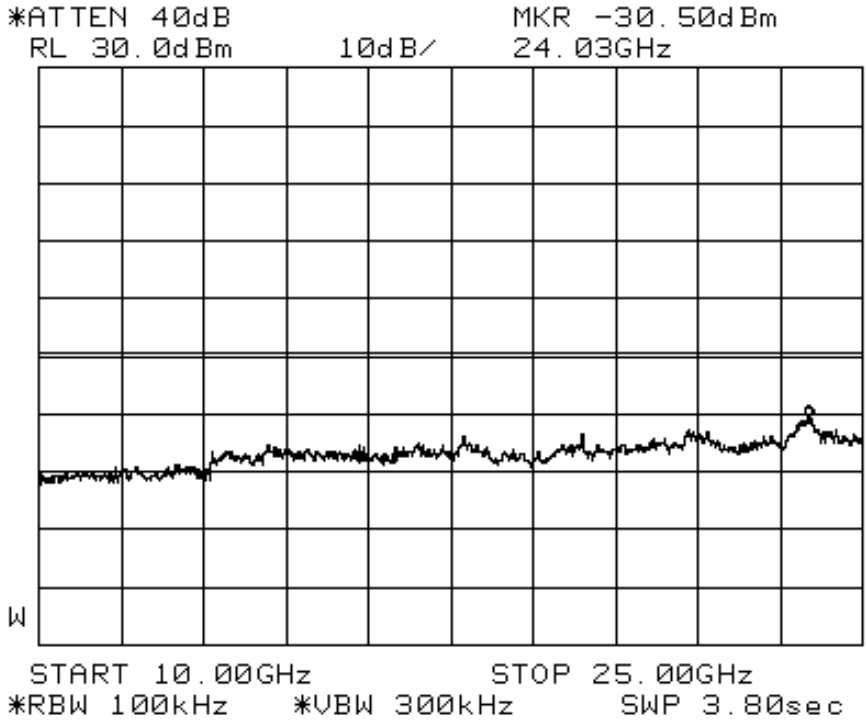


Plot 18 – Channel 39

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

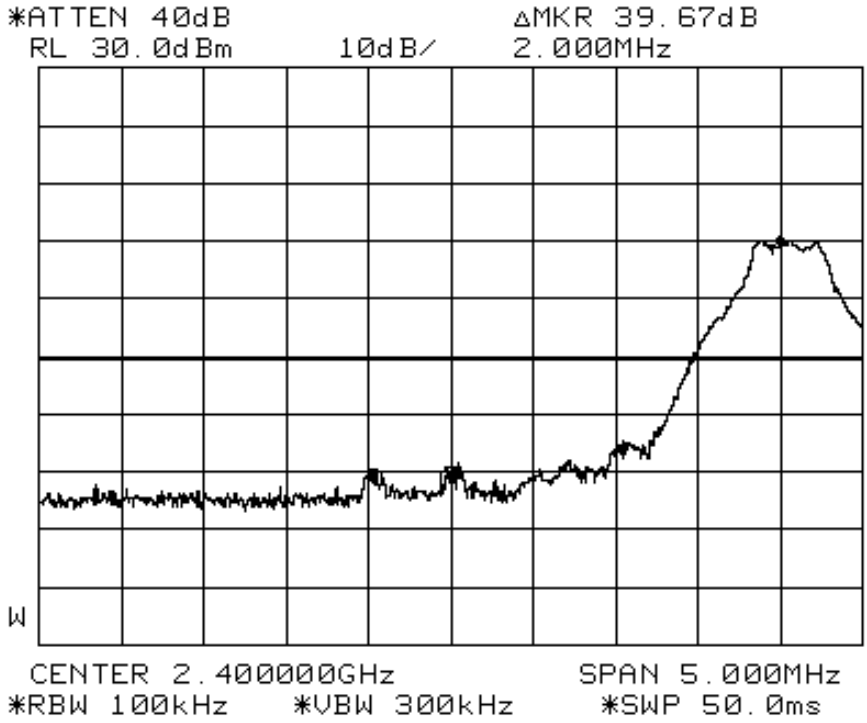


Plot 19 – Channel 78

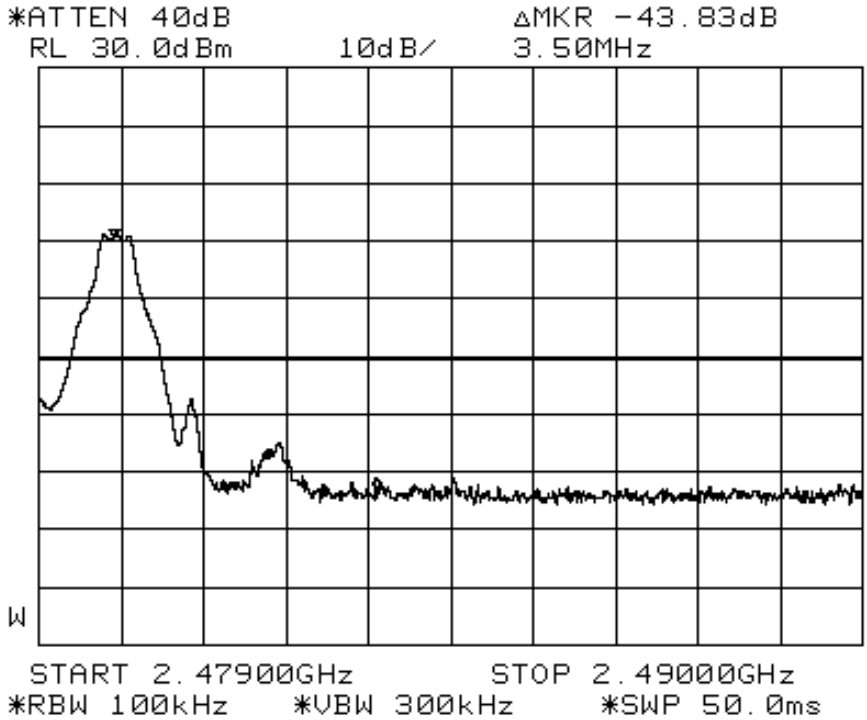


Plot 20 – Channel 78

BAND EDGE COMPLIANCE PLOTS



Plot 21 – Lower Band Edge at 2.40GHz



Plot 22 – Upper Band Edge at 2.4835GHz

FCC Part 15C (15.247(d)) Peak Power Spectral Density Results

Operation Mode: Bluetooth

The EUT shows compliance to the requirements of this section, which states the peak power spectral density of an intentional radiator (EUT) to the antenna shall not be greater than 8dBm (6.3mW) in any 3kHz band during any time interval of continuous transmission.

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
0	2.402	0.1040	6.3
39	2.441	0.1420	6.3
78	2.480	0.1310	6.3

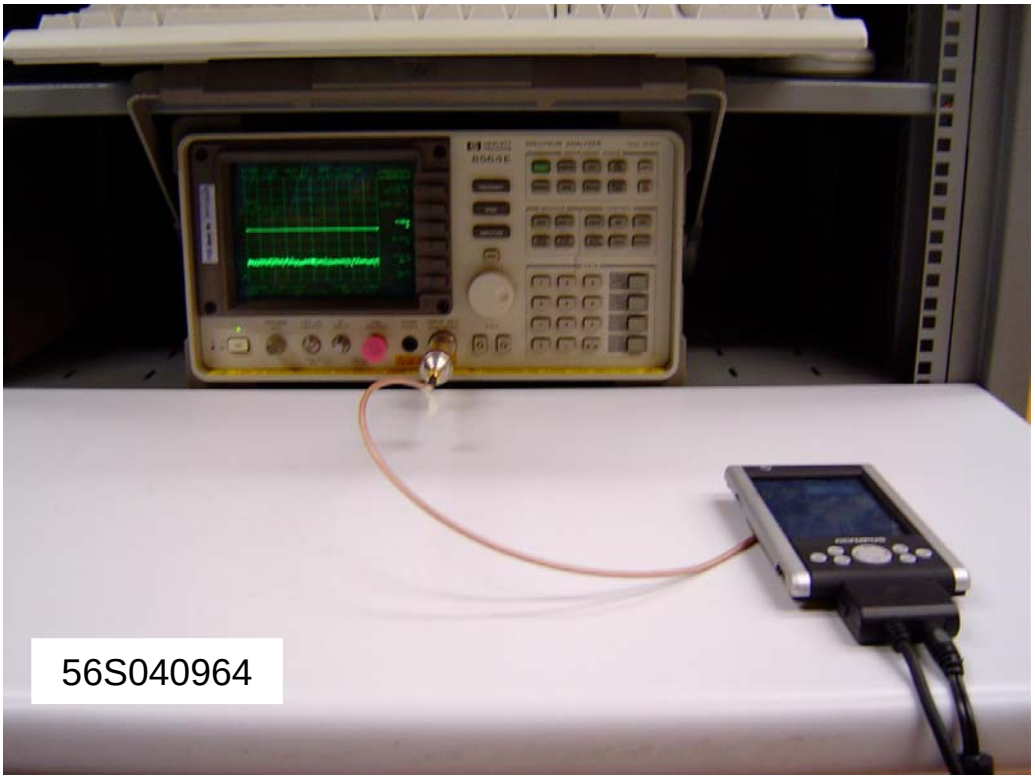
Please refer to the attached Plots 23 – 25 for details.

Tested by: DP

Notes

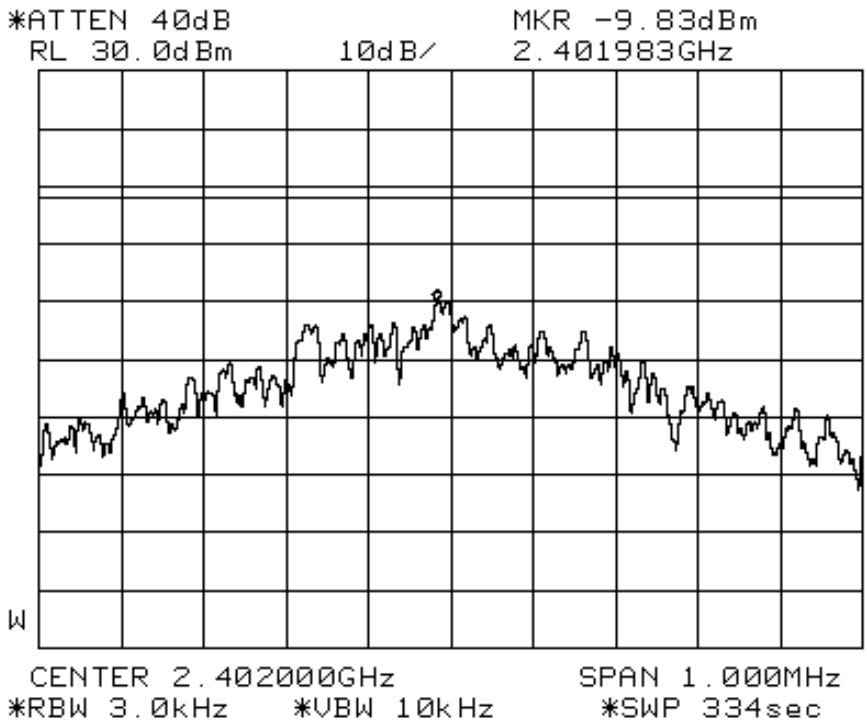
1. Environmental Conditions

Temperature	23°C
Relative Humidity	58%
Atmospheric Pressure	1030mbar

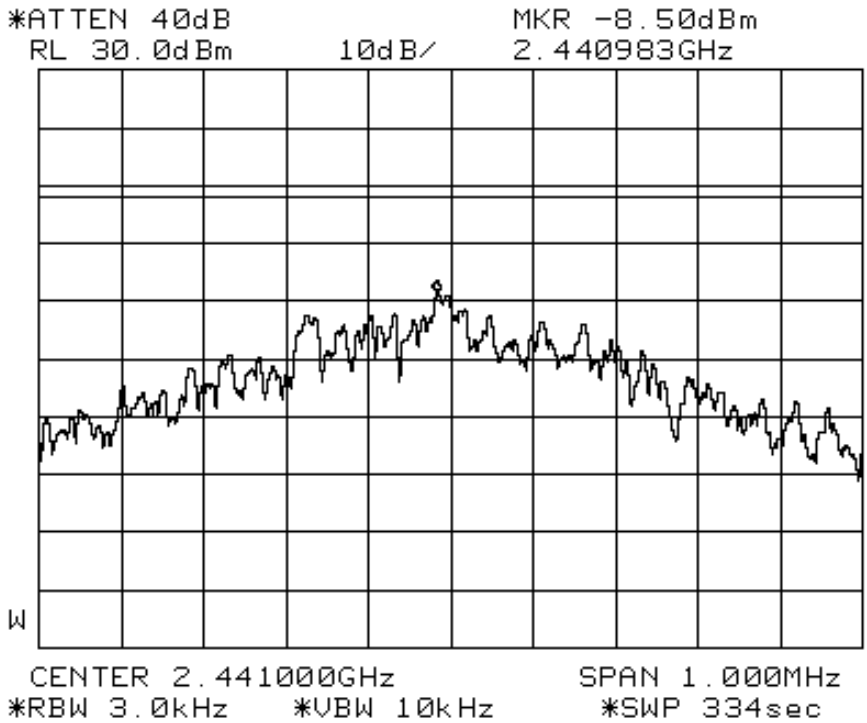


Peak Power Spectral Density Measurement Test Setup

PEAK POWER SPECTRAL DENSITY PLOTS

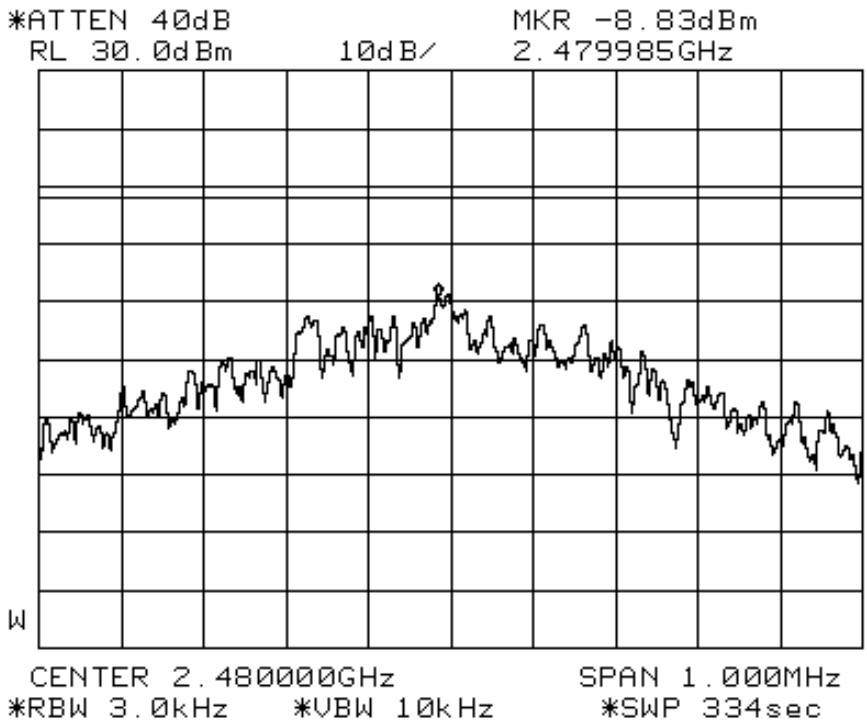


Plot 23 - Channel 0



Plot 24 - Channel 39

PEAK POWER SPECTRAL DENSITY PLOTS



Plot 25 - Channel 78

FCC Part 15C (15.247(a)(2)) Spectrum Bandwidth (6dB Bandwidth Measurement) Results

Operation Mode: 802.11b WLAN

The EUT shows compliance to the requirements of this section, which states that for system using digital modulation techniques, the minimum 6dB bandwidth shall be at least 500kHz.

Data Rate: 1Mbps

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)	Limit (Min. Bandwidth) (MHz)
1	2.412	12.08	0.5
7	2.442	11.00	0.5
13	2.472	11.00	0.5

Data Rate: 2Mbps

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)	Limit (Min. Bandwidth) (MHz)
1	2.412	11.33	0.5
7	2.442	10.33	0.5
13	2.472	10.33	0.5

Data Rate: 5.5Mbps

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)	Limit (Min. Bandwidth) (MHz)
1	2.412	9.75	0.5
7	2.442	10.83	0.5
13	2.472	11.42	0.5

Data Rate: 11Mbps

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)	Limit (Min. Bandwidth) (MHz)
1	2.412	10.67	0.5
7	2.442	10.83	0.5
13	2.472	10.17	0.5

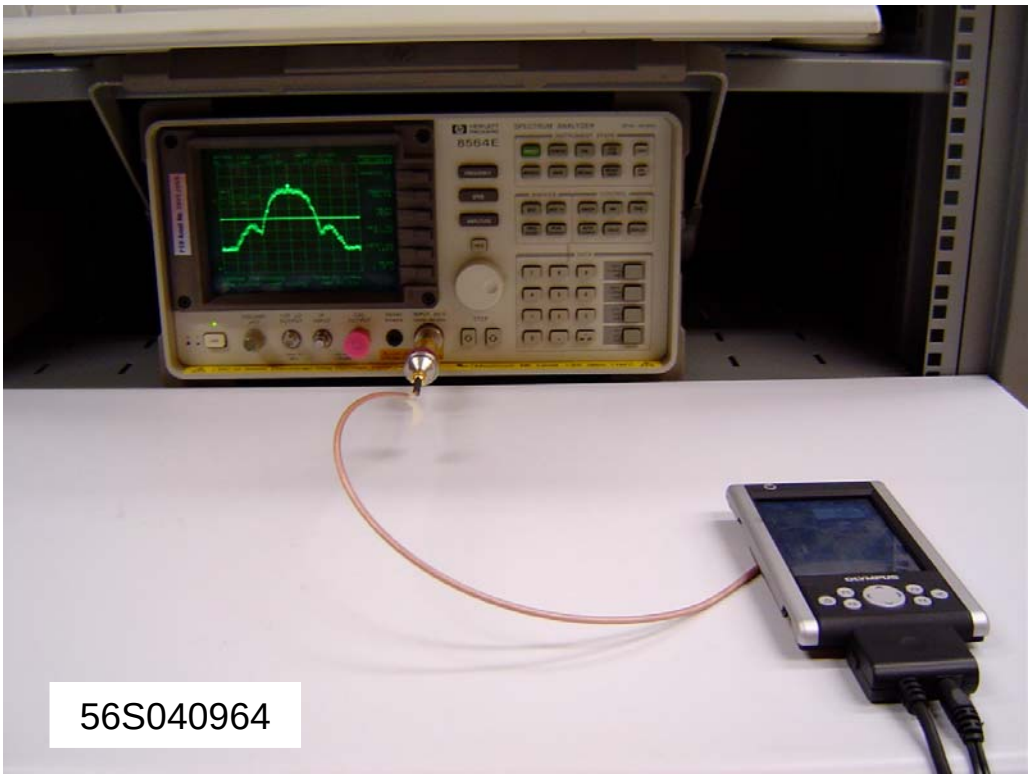
Please refer to the attached Plots 26 - 37 for details.

Tested by: DP

Notes

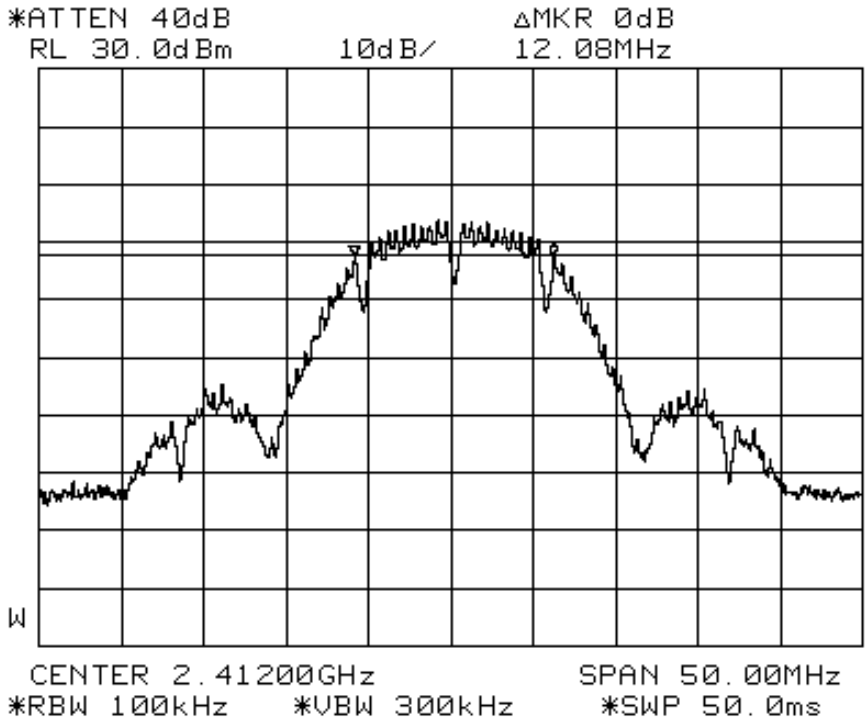
1. Environmental Conditions

Temperature	23°C
Relative Humidity	58%
Atmospheric Pressure	1030mbar

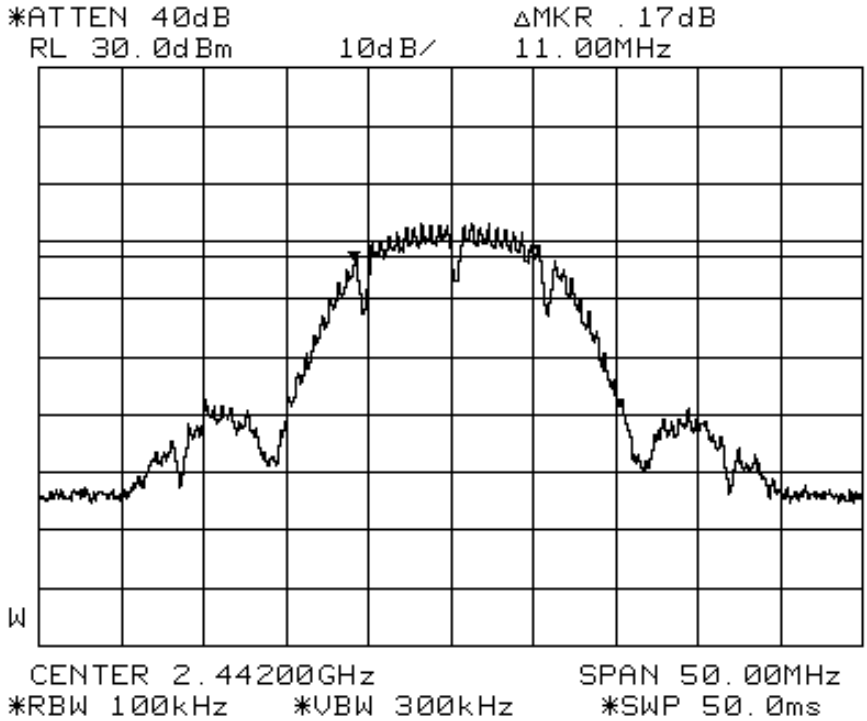


Spectrum Bandwidth Measurement Test Setup

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) PLOTS

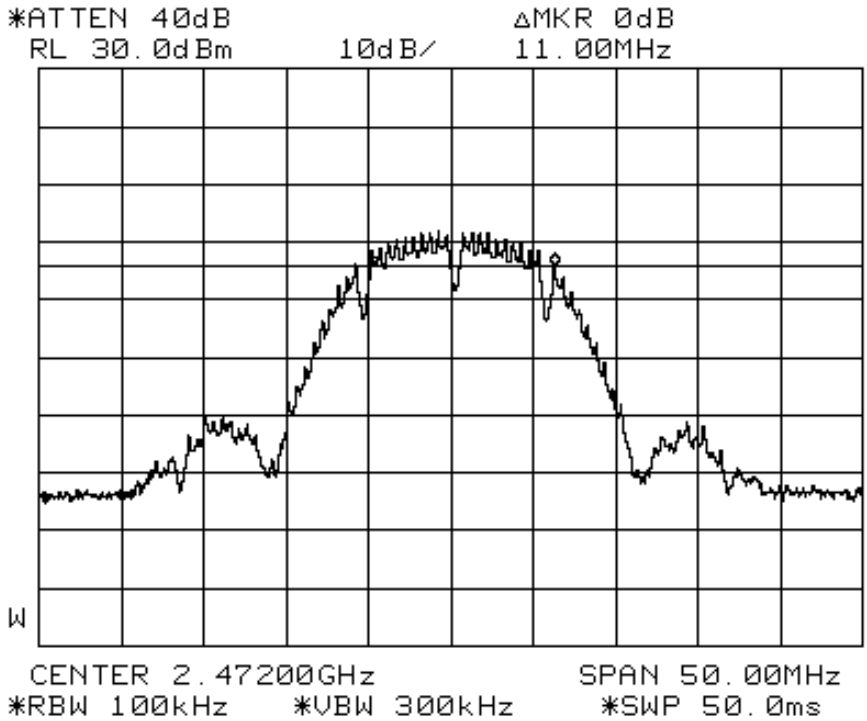


Plot 26 - Channel 1 @ 802.11b 1Mbps

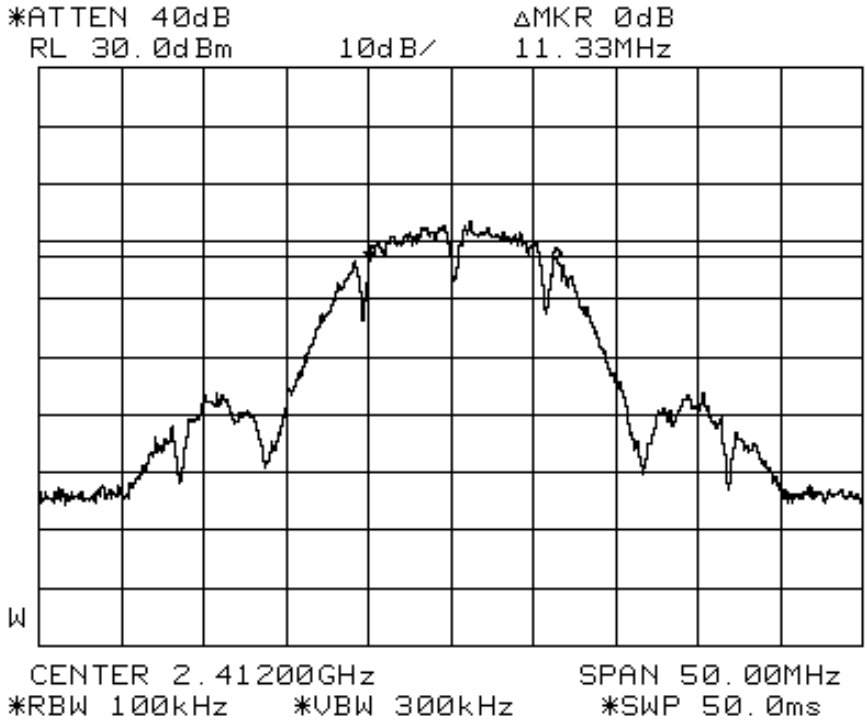


Plot 27 - Channel 7 @ 802.11b 1Mbps

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) PLOTS

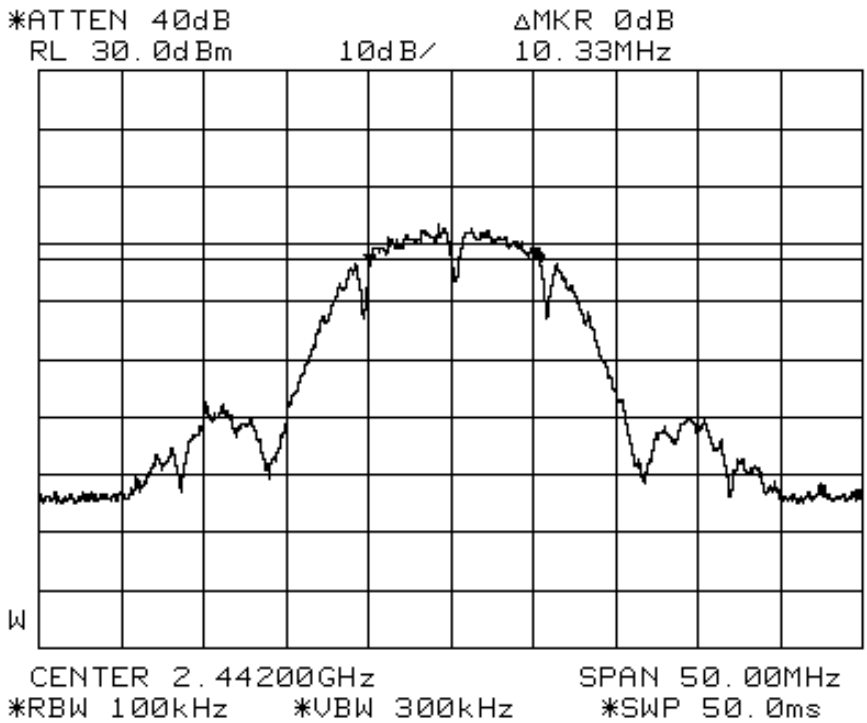


Plot 28 - Channel 13 @ 802.11b 1Mbps

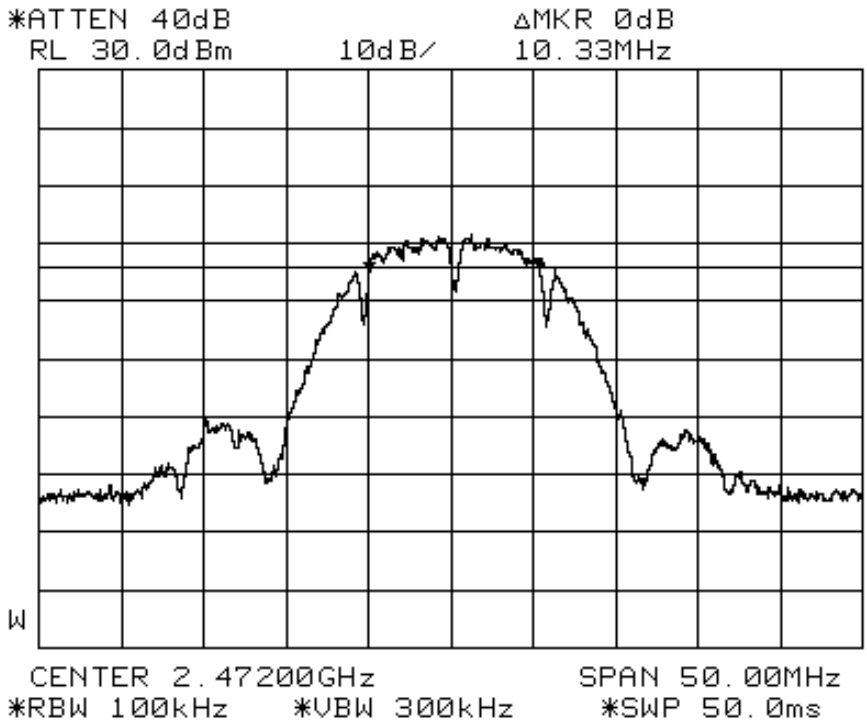


Plot 29 - Channel 1 @ 802.11b 2Mbps

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) PLOTS

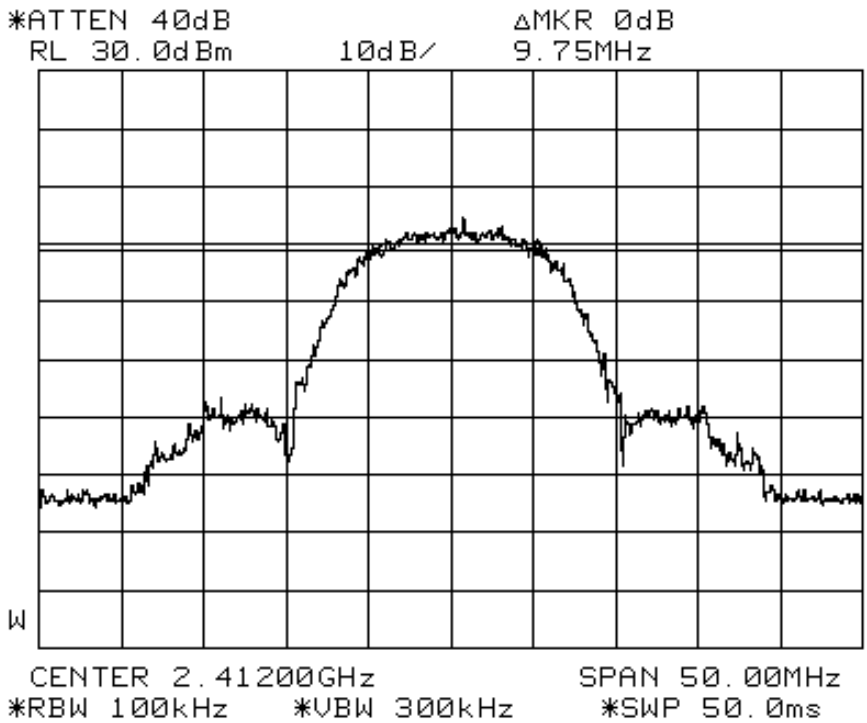


Plot 30 - Channel 7 @ 802.11b 2Mbps

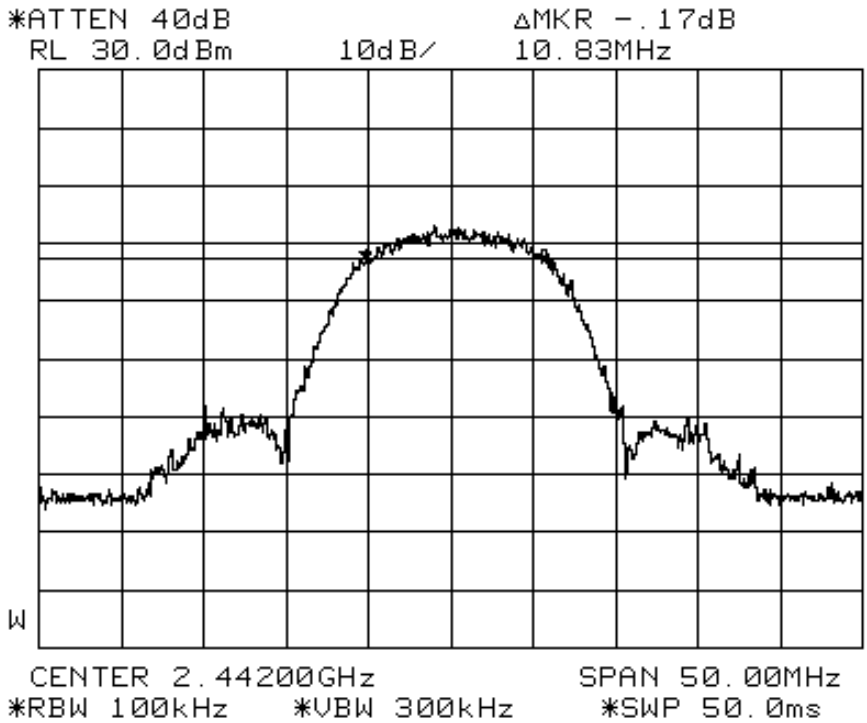


Plot 31 - Channel 13 @ 802.11b 2Mbps

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) PLOTS

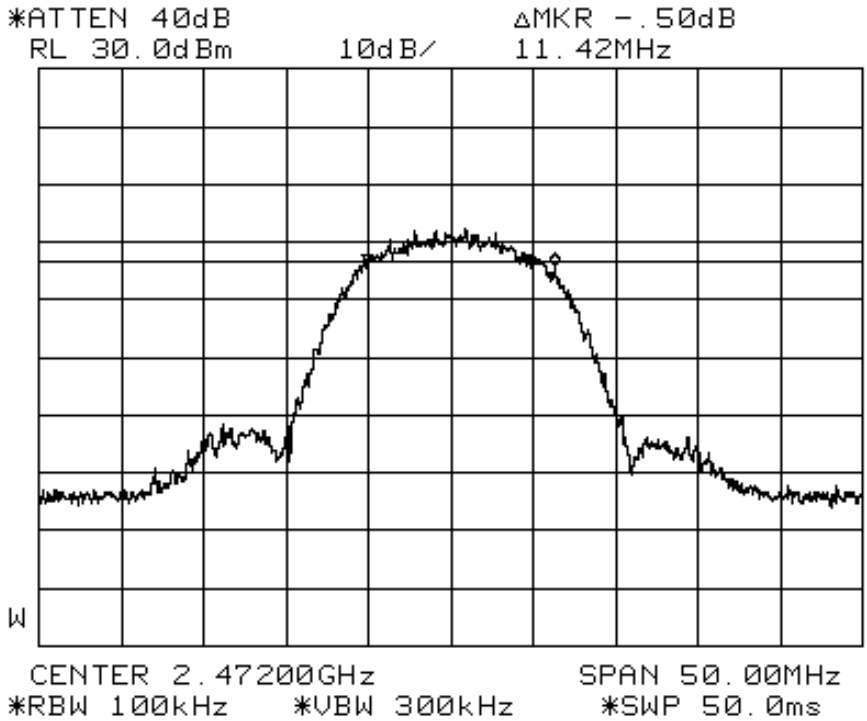


Plot 32 – Channel 1 @ 802.11b 5.5Mbps

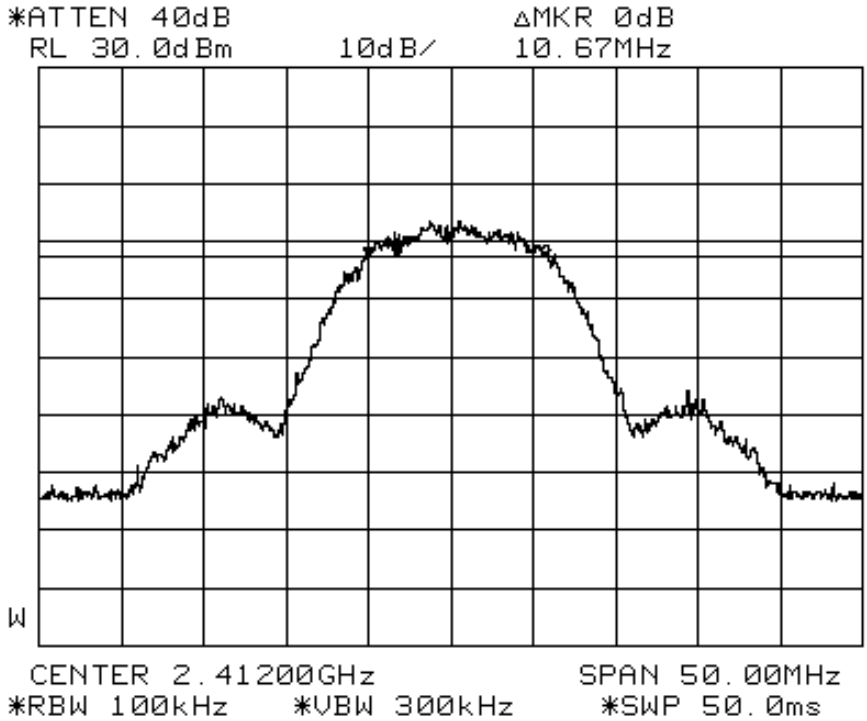


Plot 33 – Channel 7 @ 802.11b 5.5Mbps

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) PLOTS

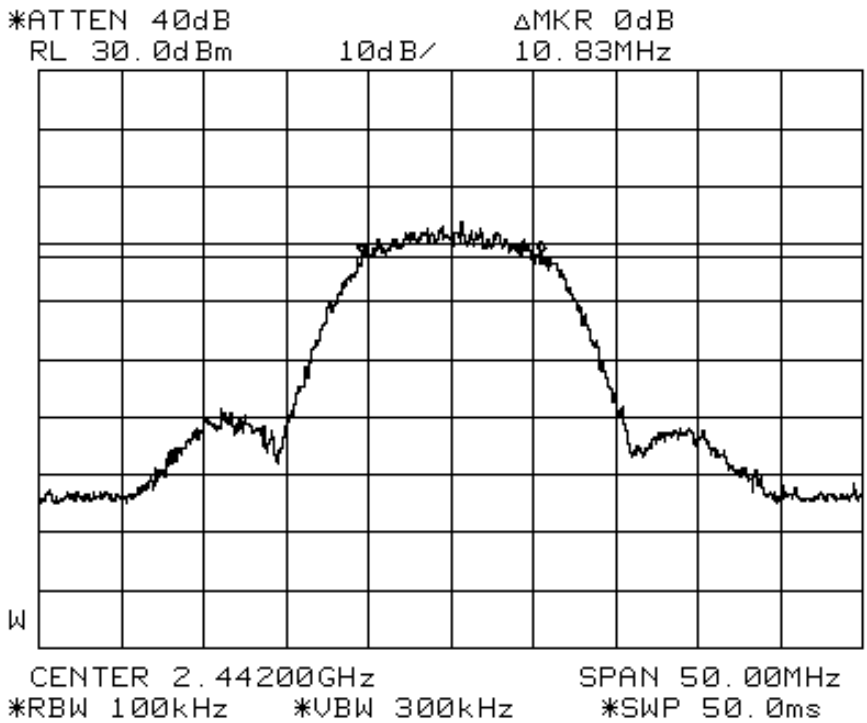


Plot 34 – Channel 13 @ 802.11b 5.5Mbps

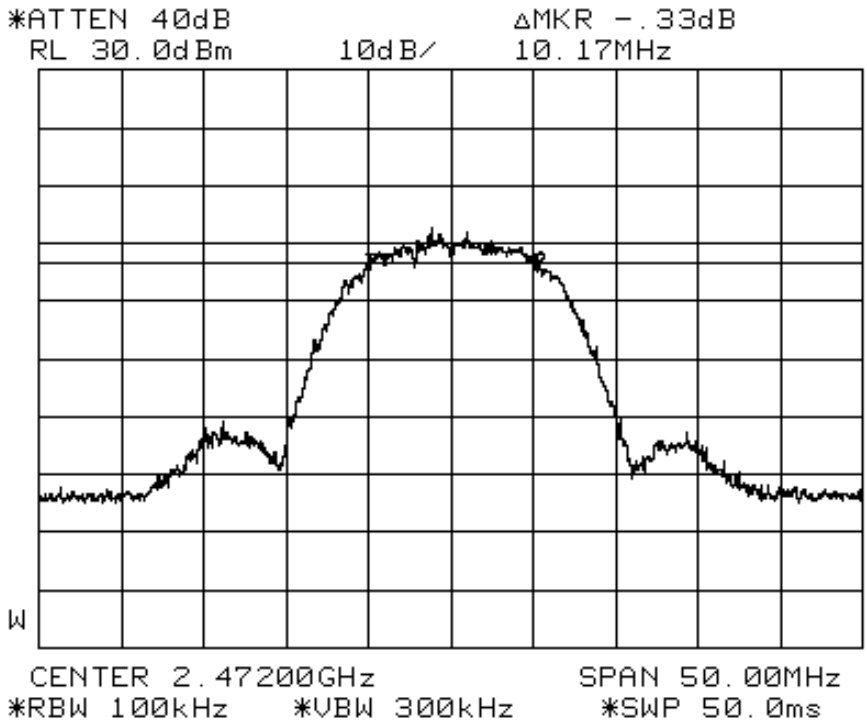


Plot 35 – Channel 1 @ 802.11b 11Mbps

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) PLOTS



Plot 36 – Channel 9 @ 802.11b 11Mbps



Plot 37 – Channel 13 @ 802.11b 11Mbps

FCC Part 15C (15.247(b)(1)) Maximum Peak Power Results

Operation Mode: 802.11b WLAN

The EUT shows compliance to the requirements of this section, which states the peak power of an intentional radiator (EUT) shall not exceed 30dBm (1 Watt).

Data Rate: 1Mbps

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
1	2.412	0.01679	1
7	2.442	0.01429	1
13	2.472	0.01280	1

Data Rate: 2Mbps

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
1	2.412	0.01652	1
7	2.442	0.01443	1
13	2.472	0.01283	1

Data Rate: 5.5Mbps

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
1	2.412	0.02140	1
7	2.442	0.01941	1
13	2.472	0.01750	1

Data Rate: 11Mbps

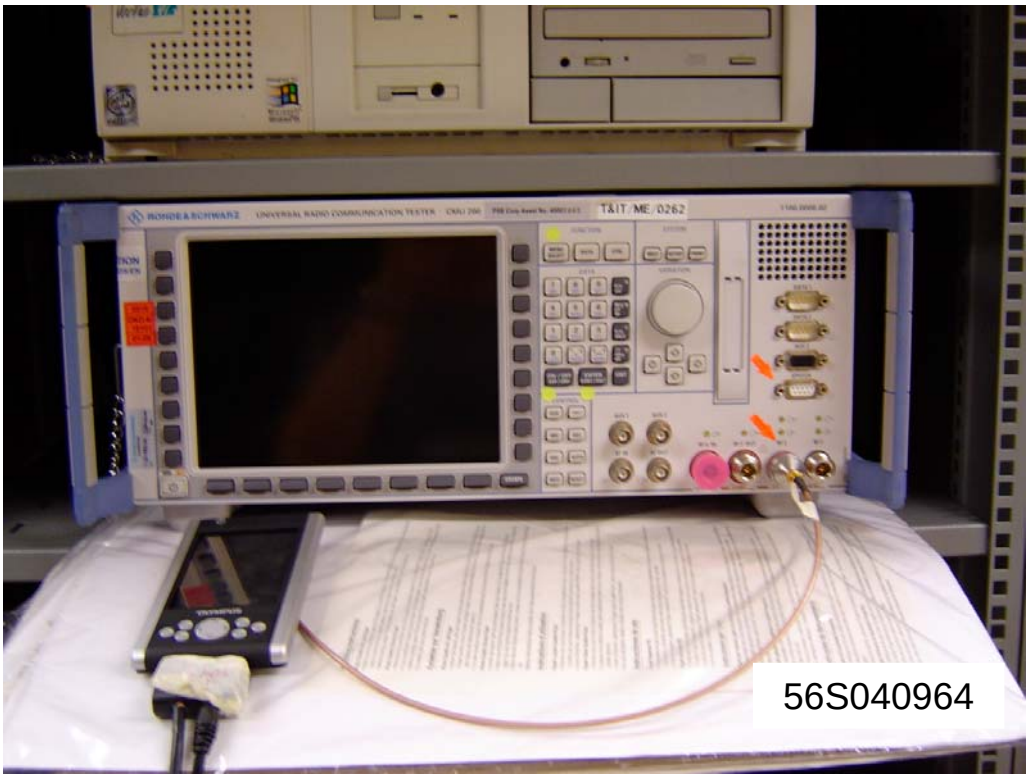
Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
1	2.412	0.03030	1
7	2.442	0.02361	1
13	2.472	0.02157	1

Tested by: DP

Notes

1. Environmental Conditions — Temperature: 23°C; Relative Humidity: 58%; Atmospheric Pressure: 1030mbar

2. Power analyser of Universal Radio Communication Tester was used for power measurement with peak detection as mode of measurement. The power analyser mode supports a wideband power measurement ranging from 100kHz to 2700MHz.



Maximum Peak Power Measurement Test Setup

FCC Part 15C (15.247(c)) RF Conducted Spurious Emissions & Band Edge Compliance at the Transmitter Antenna Results

Operation Mode: 802.11b WLAN

The EUT shows compliance to the requirements of this section, which states in any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator (EUT) is operating, the RF power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power.

The RF conducted spurious emissions were scanned from 30MHz to 25GHz for following channels. No significant signal was found and they were below the specified limit. Please refer to the attached Plots 38 - 61 for details.

1Mbps
Channels 1, 7 and 13

2Mbps
Channels 1, 7 and 13

5.5Mbps
Channels 1, 7 and 13

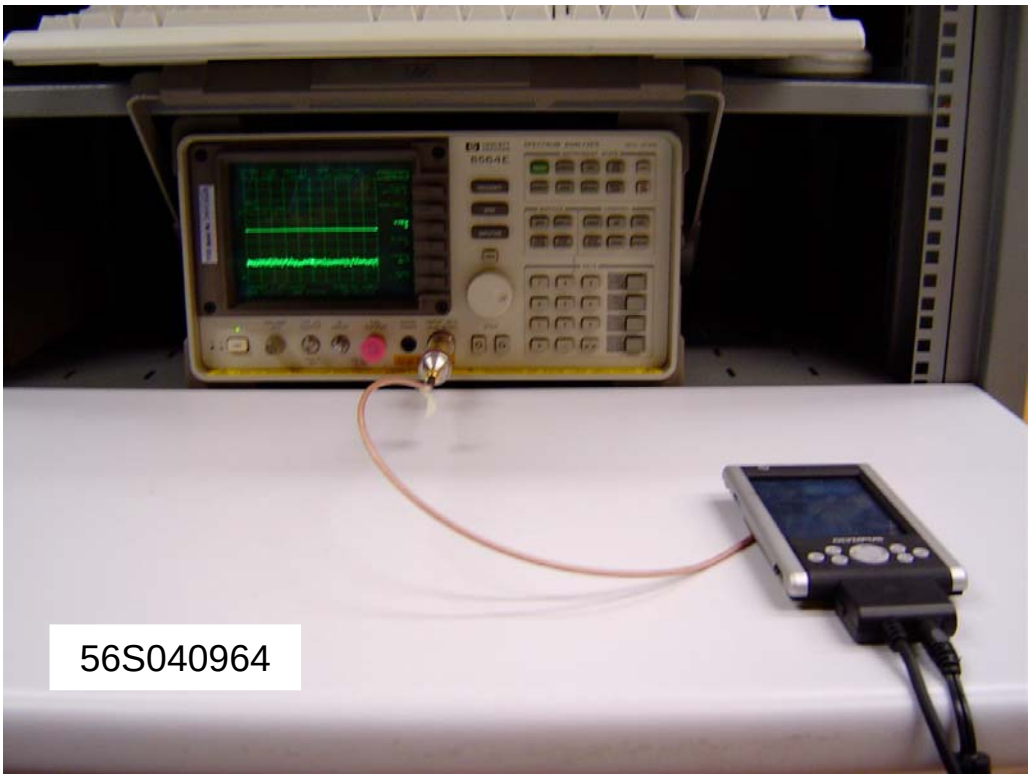
11Mbps
Channels 1, 7 and 13

The conducted spurious at lower and upper band-edges (2.4000GHz and 2.4835GHz) were scanned. The spurious emissions at band-edges were found below the specified limit. Please refer to the attached Plots 62 - 69 for details.

Tested by: DP

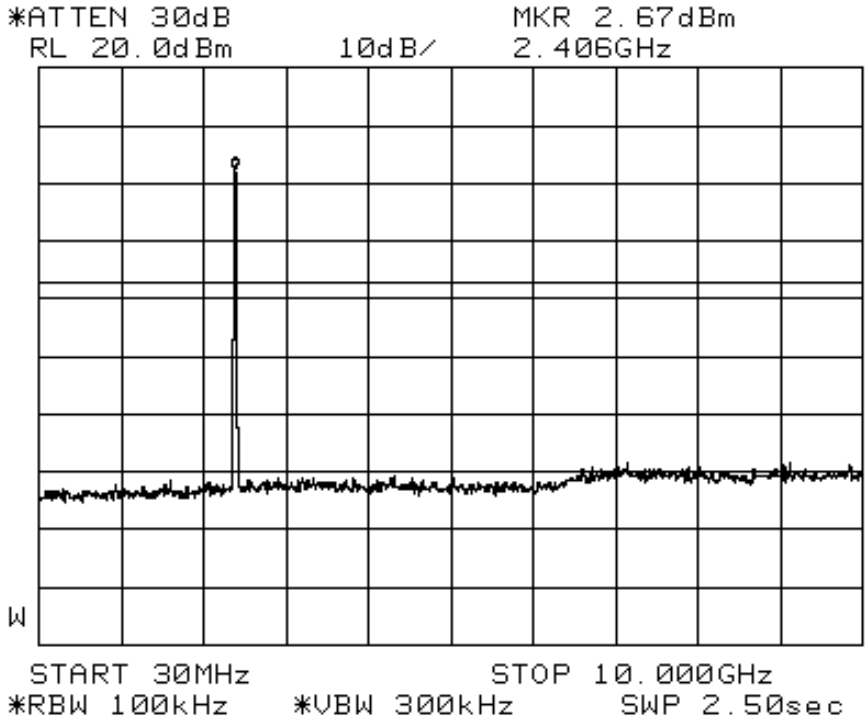
Notes

1.	Environmental Conditions	Temperature	23°C
		Relative Humidity	58%
		Atmospheric Pressure	1030mbar

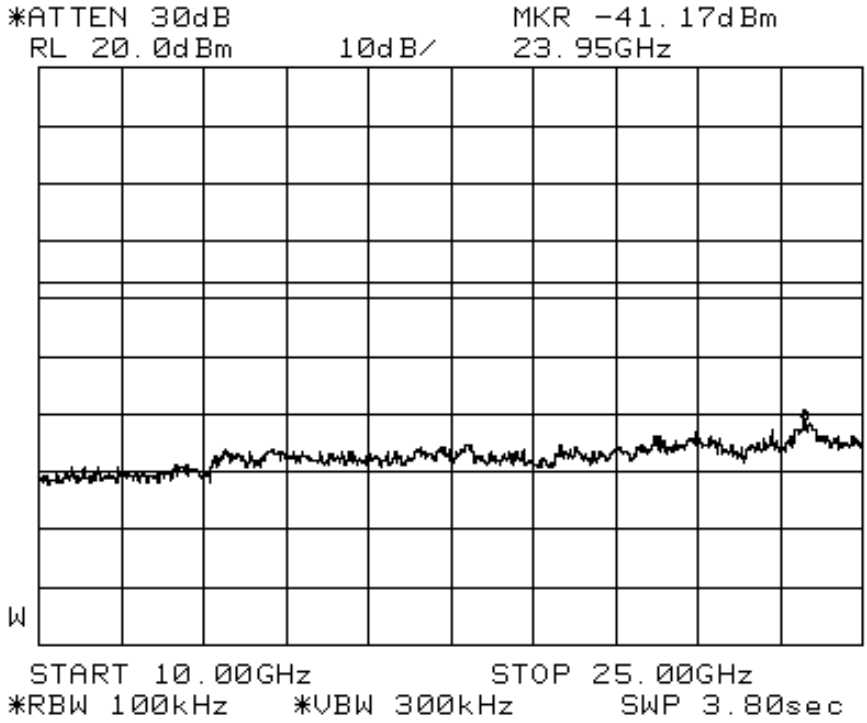


RF Conducted Spurious & Band Edge Measurement Test Setup

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

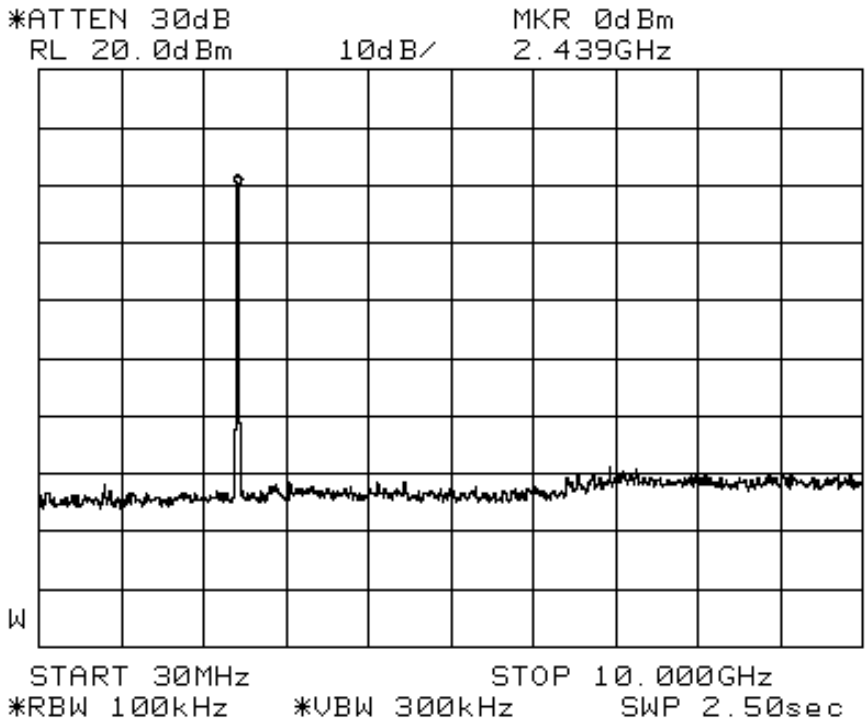


Plot 38 - Channel 1 @ 802.11b 1Mbps (30MHz-10GHz)

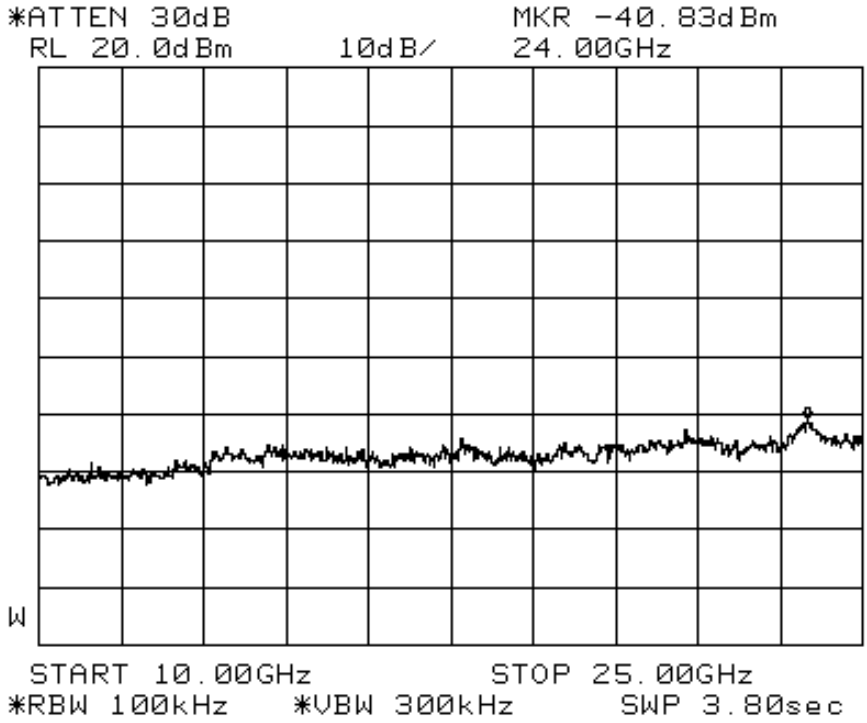


Plot 39 - Channel 1 @ 802.11b 1Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

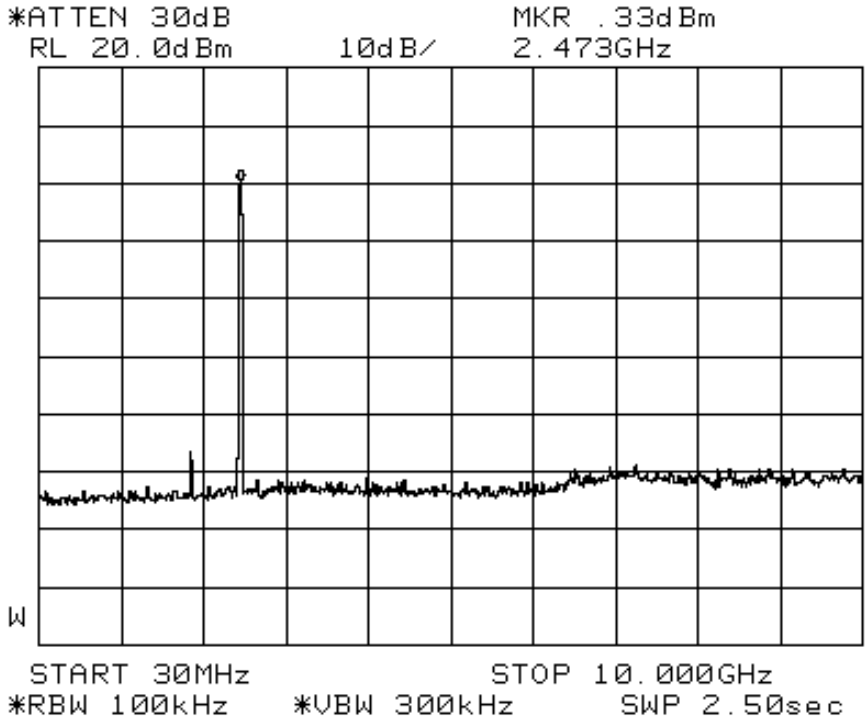


Plot 40 - Channel 7 @ 802.11b 1Mbps (30MHz-10GHz)

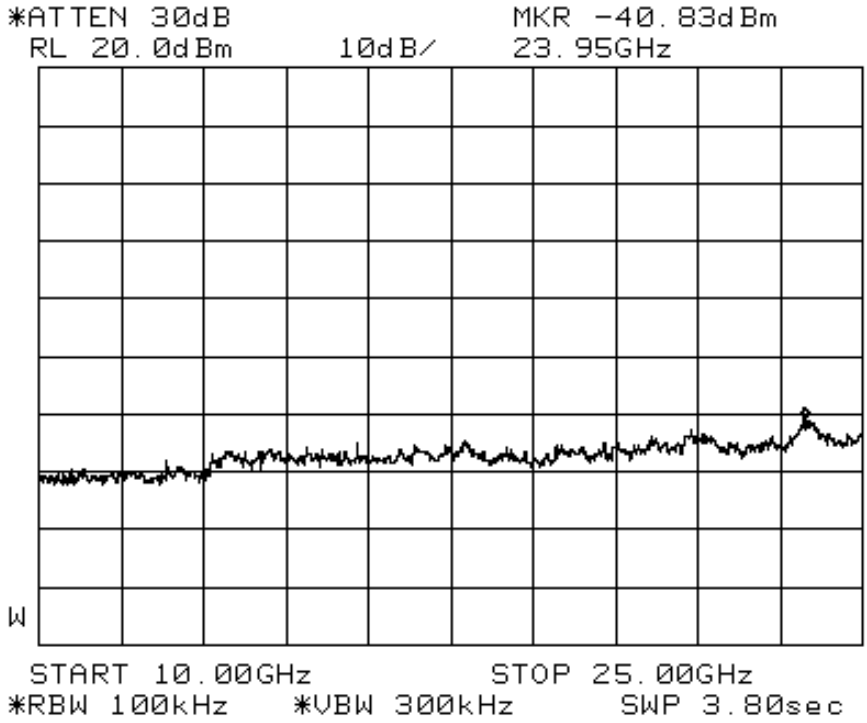


Plot 41 - Channel 7 @ 802.11b 1Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

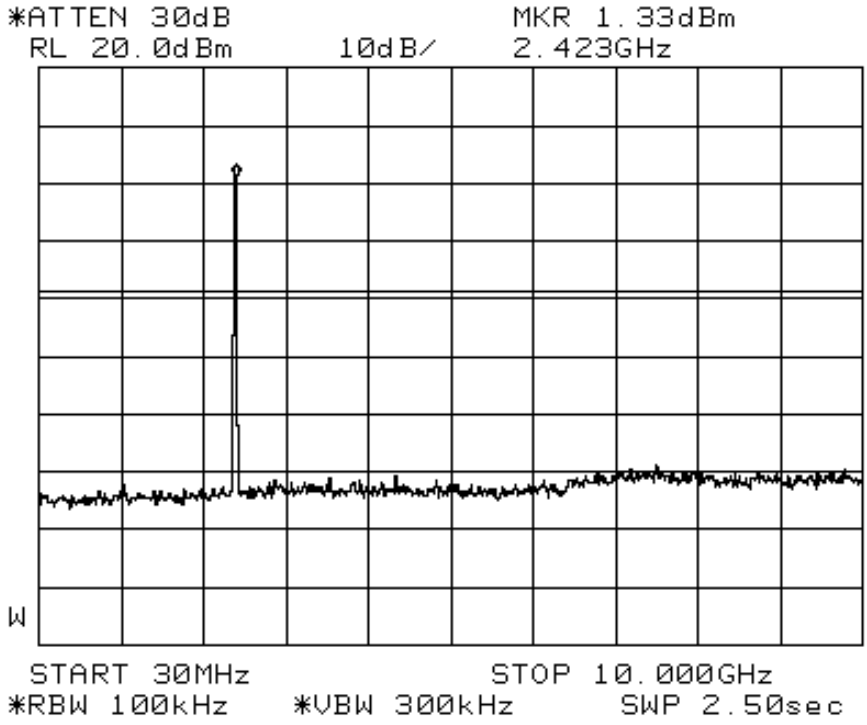


Plot 42 - Channel 13 @ 802.11b 1Mbps (30MHz-10GHz)

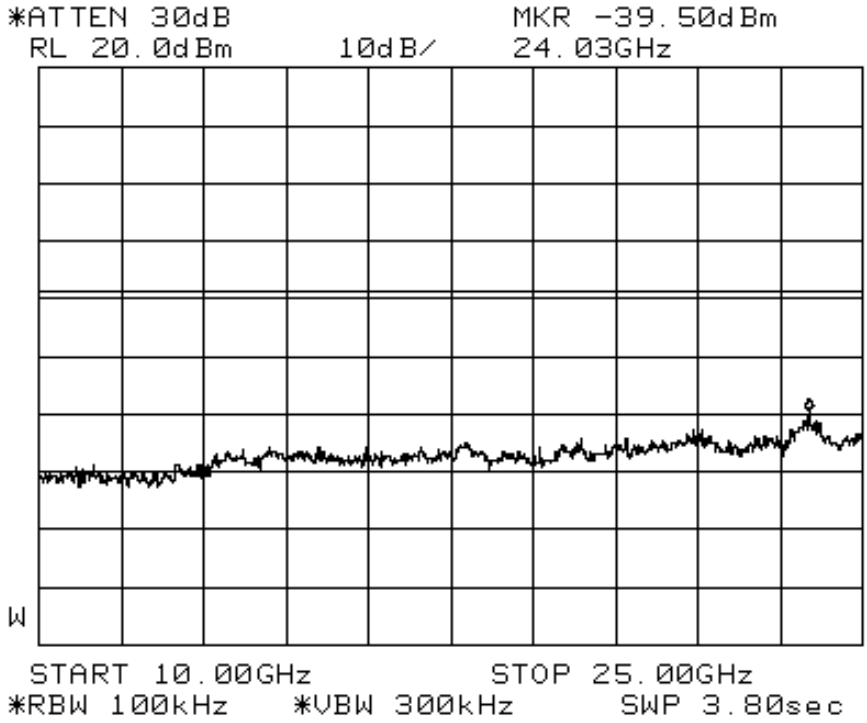


Plot 43 - Channel 13 @ 802.11b 1Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

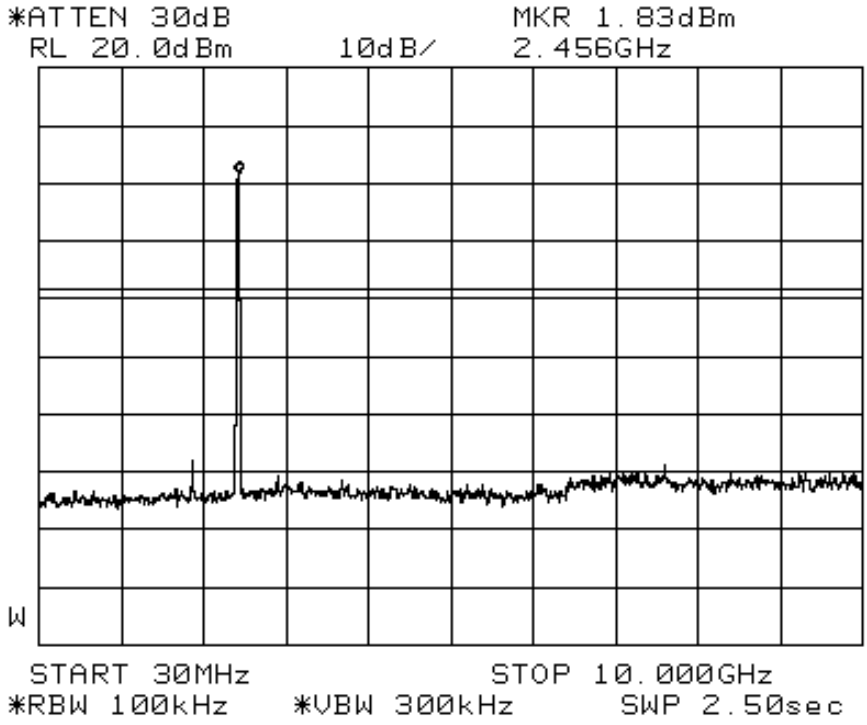


Plot 44 - Channel 1 @ 802.11b 2Mbps (30MHz-10GHz)

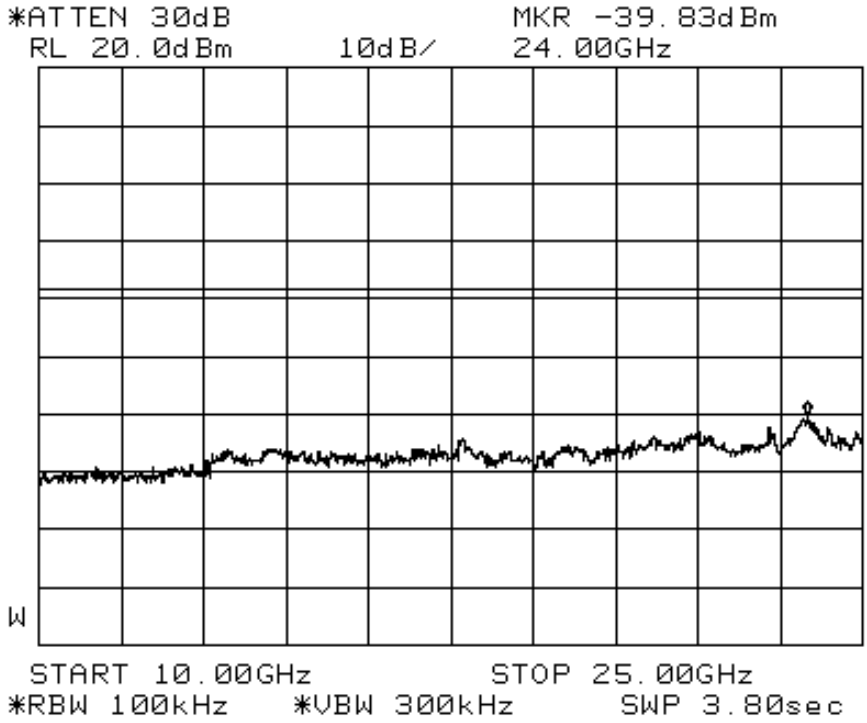


Plot 45 - Channel 1 @ 802.11b 2Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

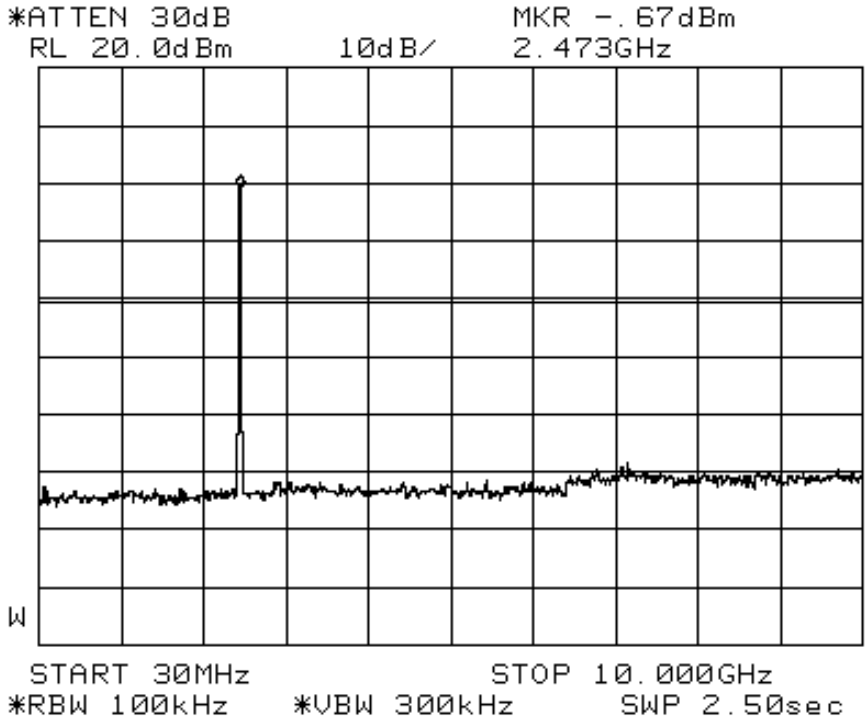


Plot 46 - Channel 7 @ 802.11b 2Mbps (30MHz-10GHz)

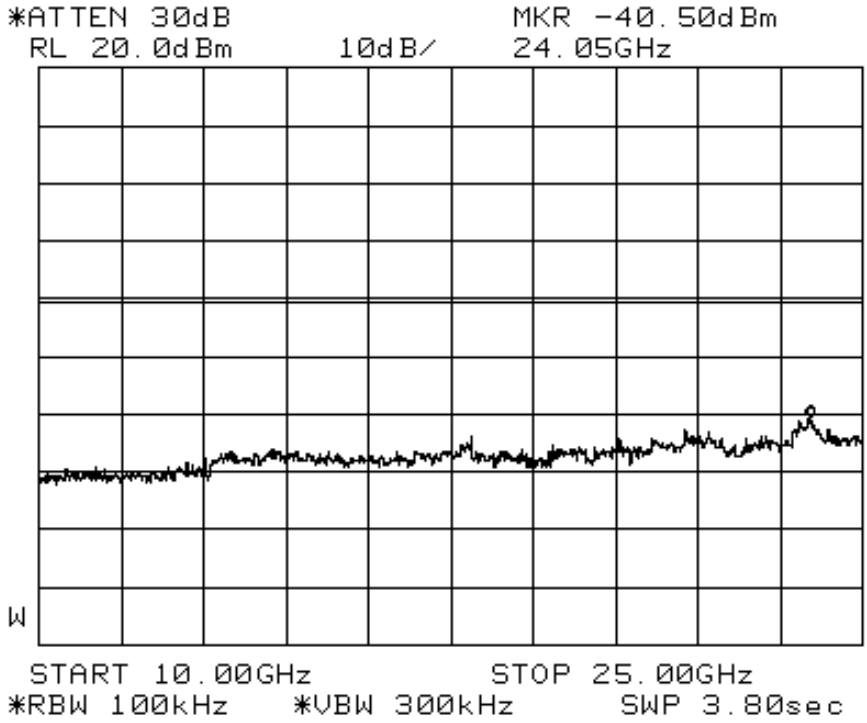


Plot 47 - Channel 7 @ 802.11b 2Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

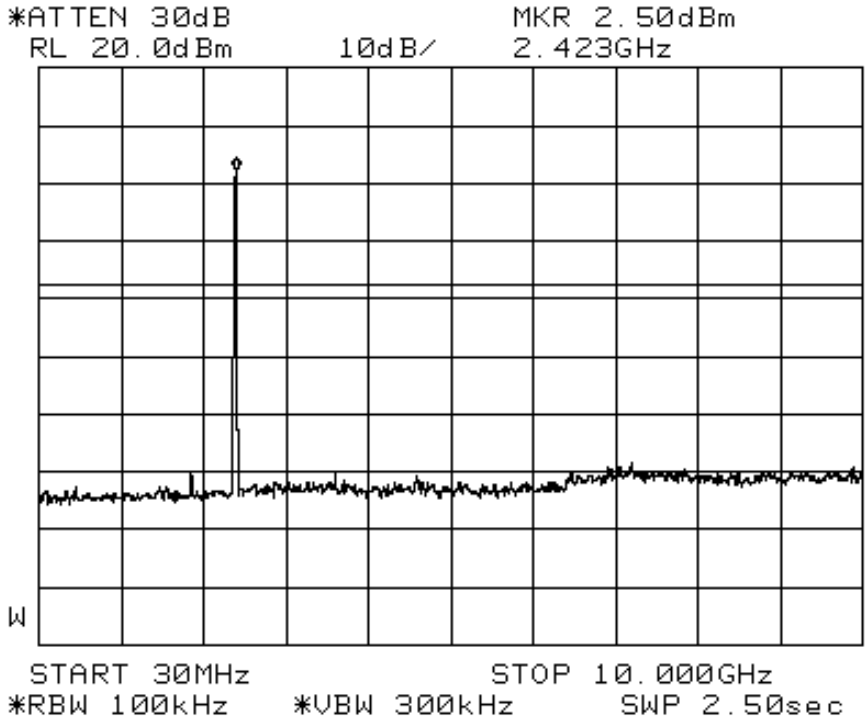


Plot 48 - Channel 13 @ 802.11b 2Mbps (30MHz-10GHz)

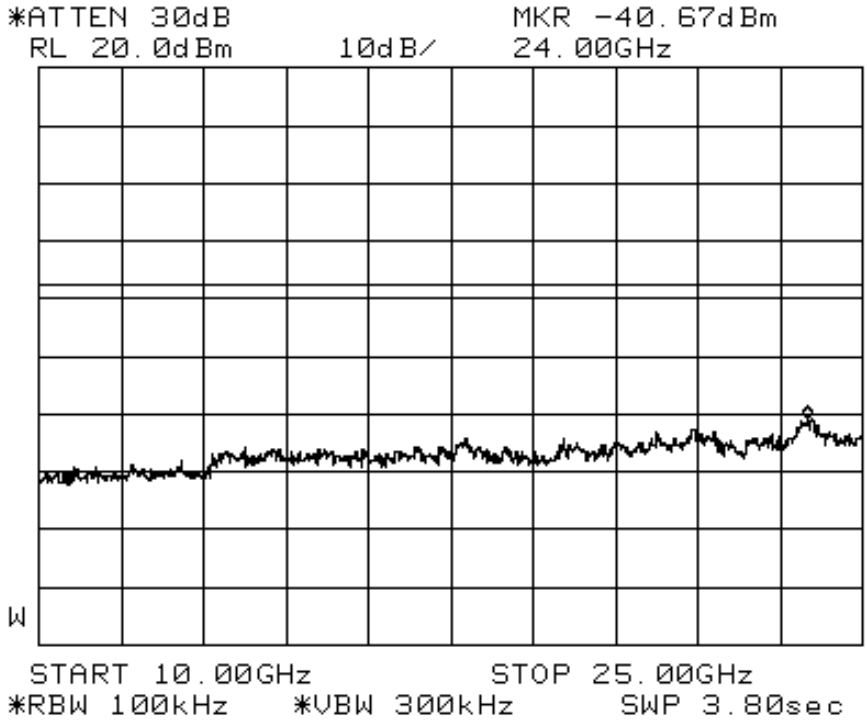


Plot 49 - Channel 13 @ 802.11b 2Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

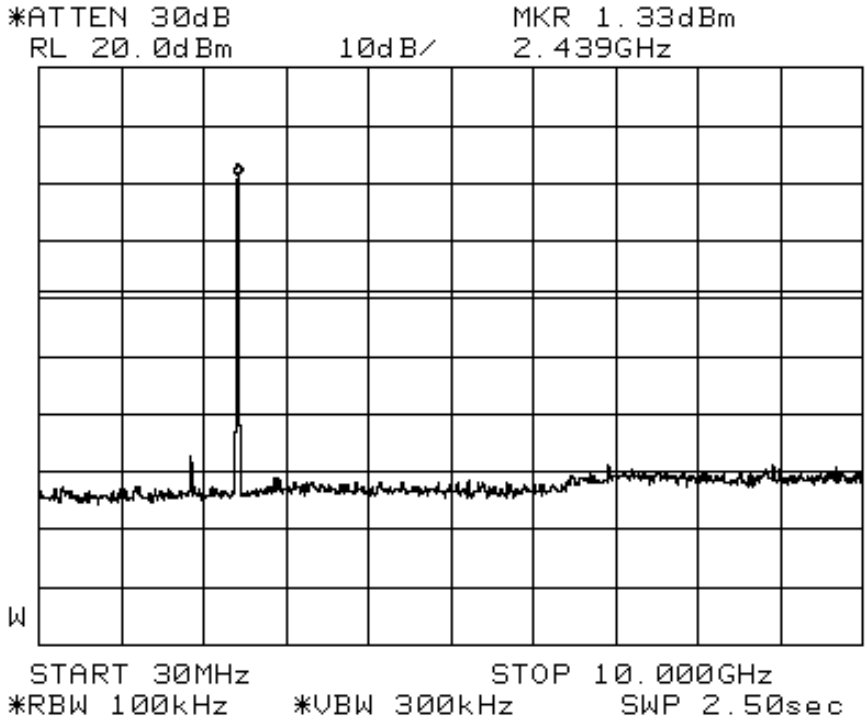


Plot 50 - Channel 1 @ 802.11b 5.5Mbps (30MHz-10GHz)

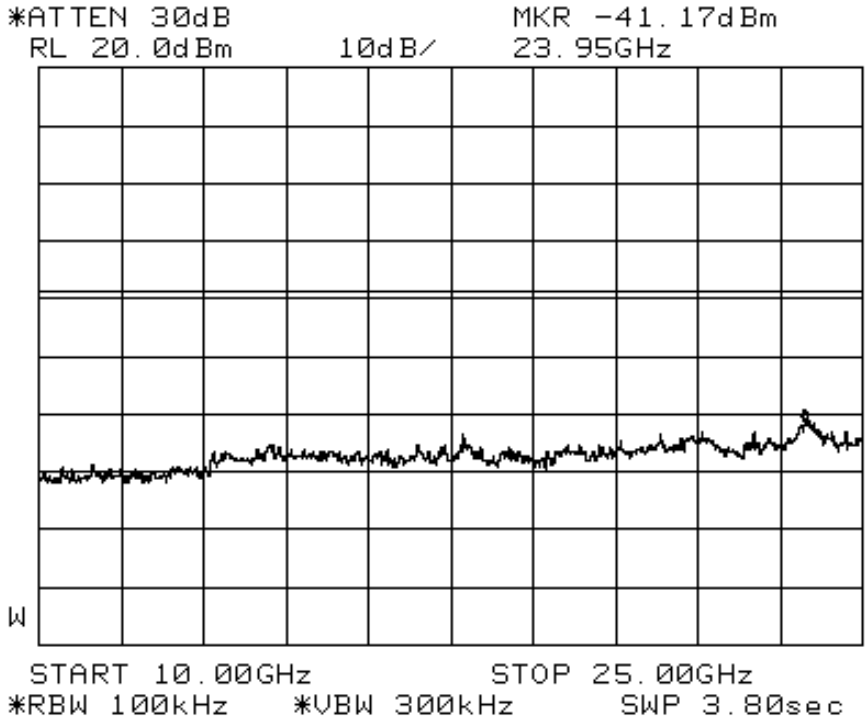


Plot 51 - Channel 1 @ 802.11b 5.5Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

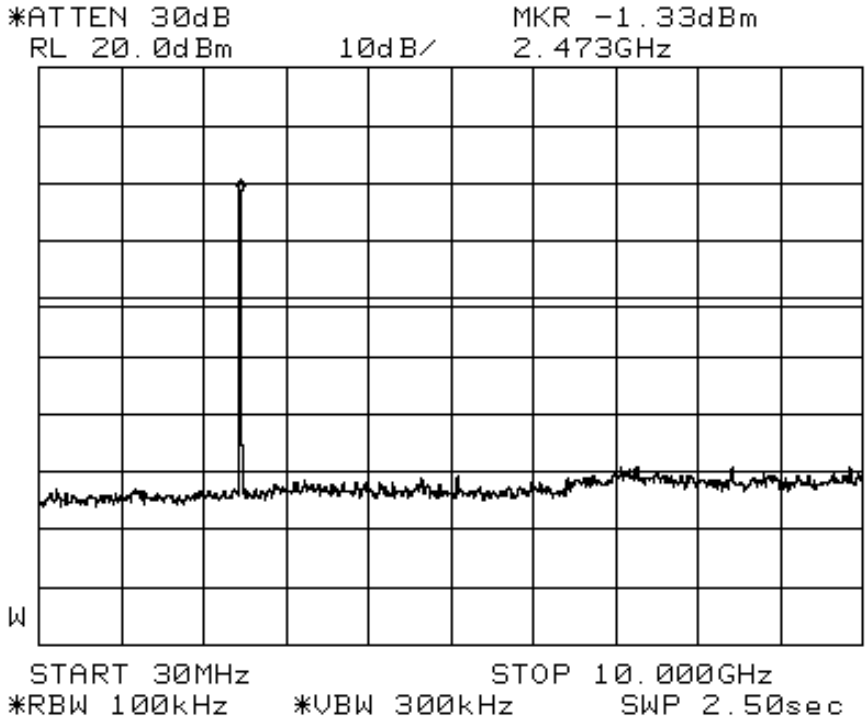


Plot 52 - Channel 7 @ 802.11b 5.5Mbps (30MHz-10GHz)

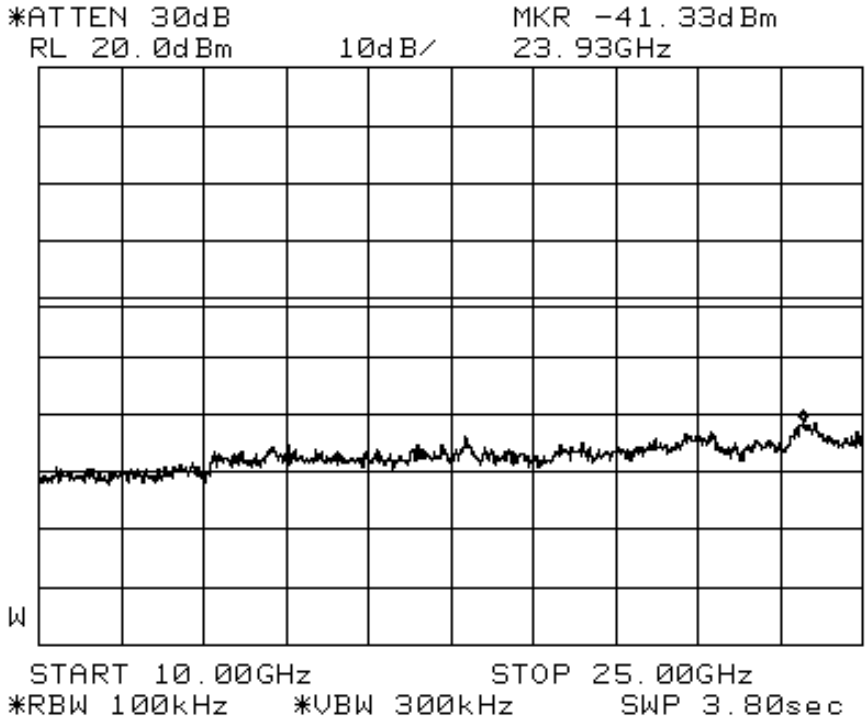


Plot 53 - Channel 7 @ 802.11b 5.5Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

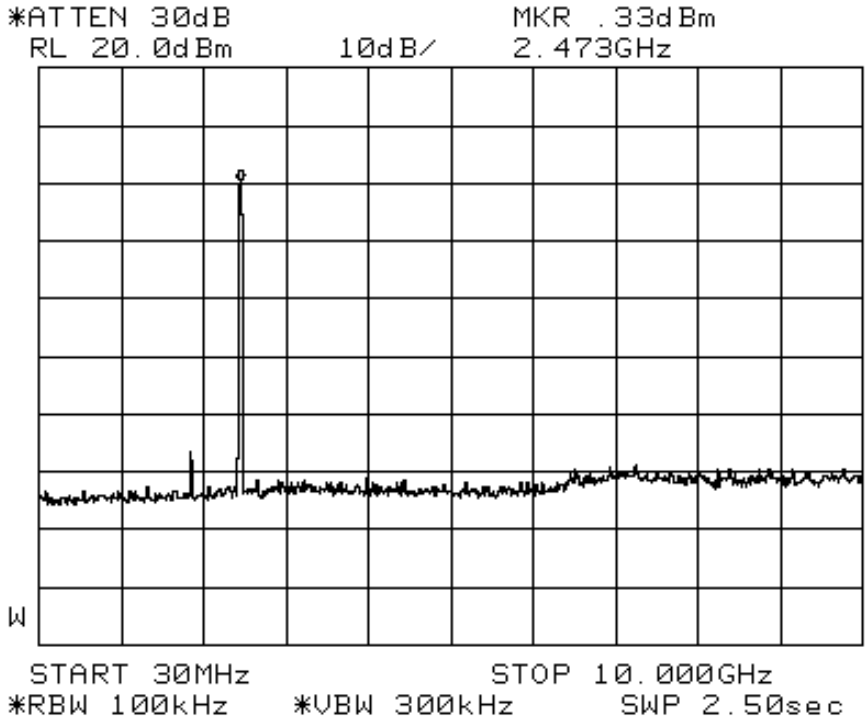


Plot 54 - Channel 13 @ 802.11b 5.5Mbps (30MHz-10GHz)

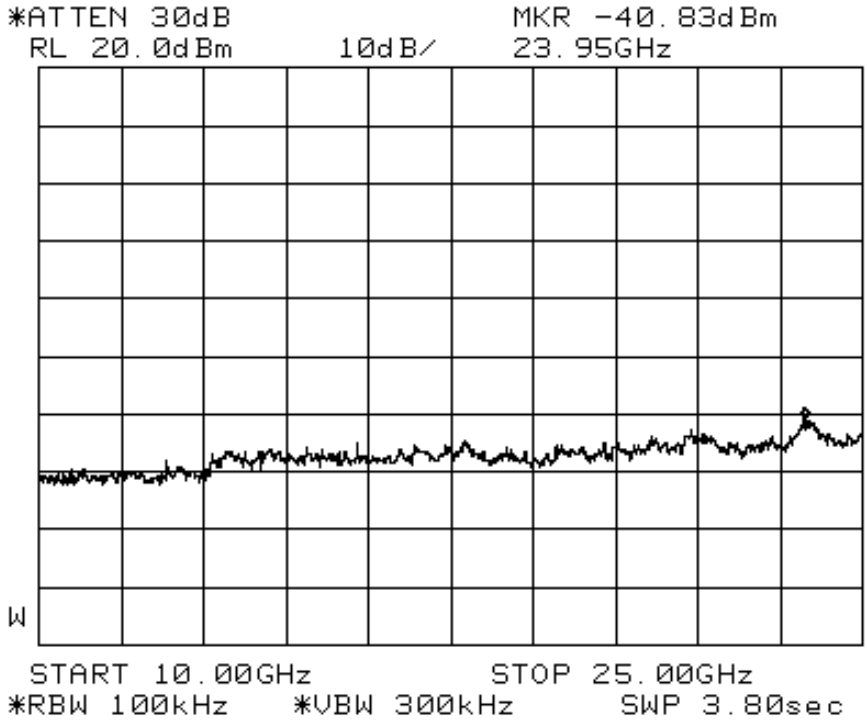


Plot 55 - Channel 13 @ 802.11b 5.5Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

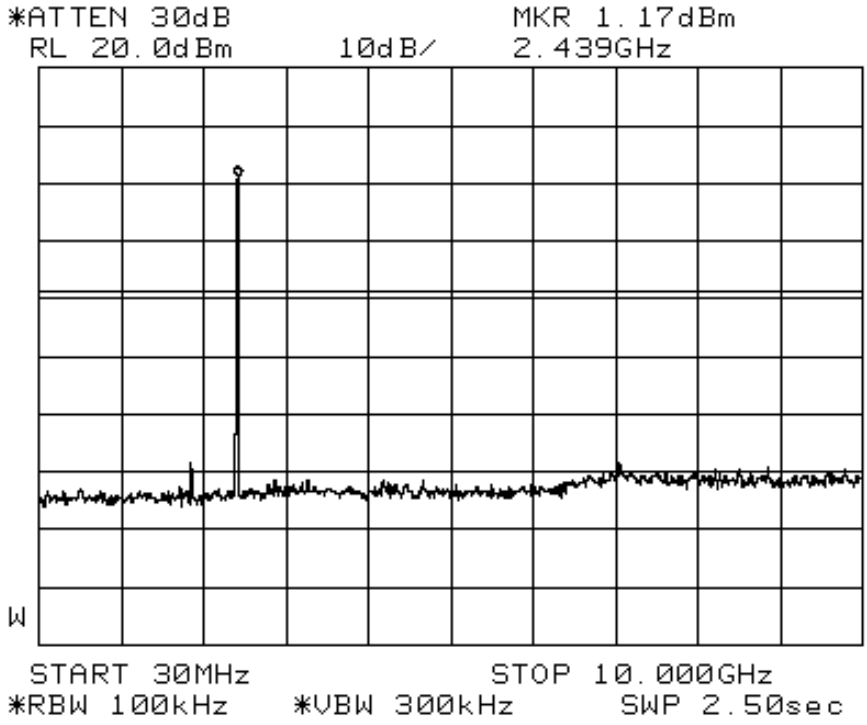


Plot 56 - Channel 1 @ 802.11b 11Mbps (30MHz-10GHz)

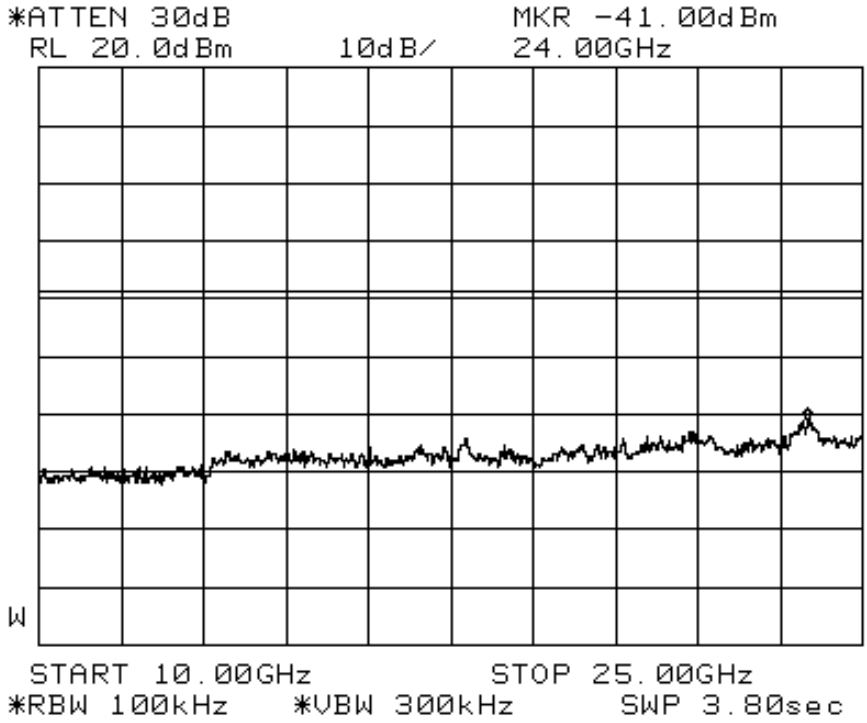


Plot 57 - Channel 1 @ 802.11b 11Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

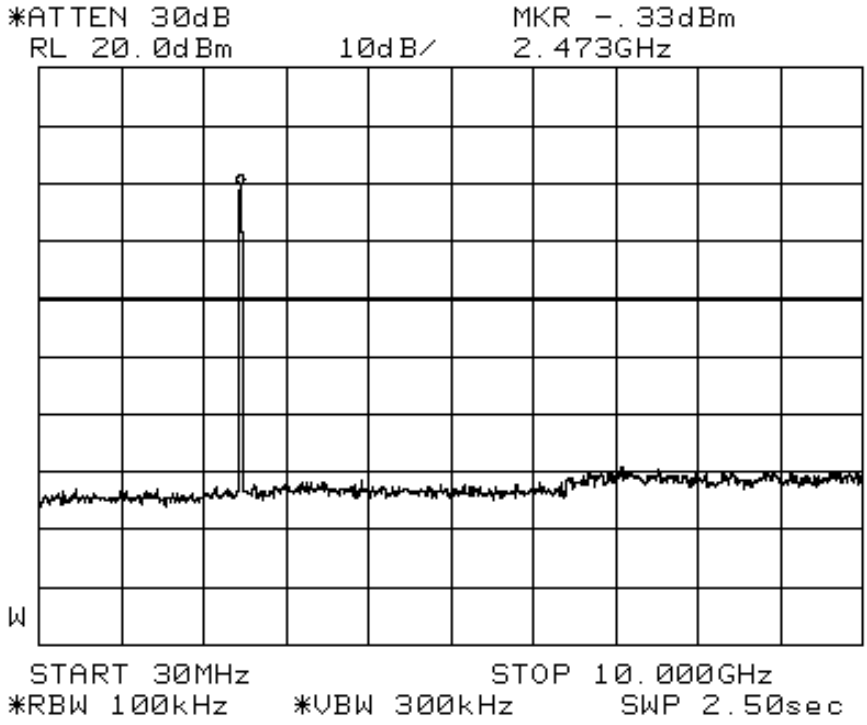


Plot 58 - Channel 7 @ 802.11b 11Mbps (30MHz-10GHz)

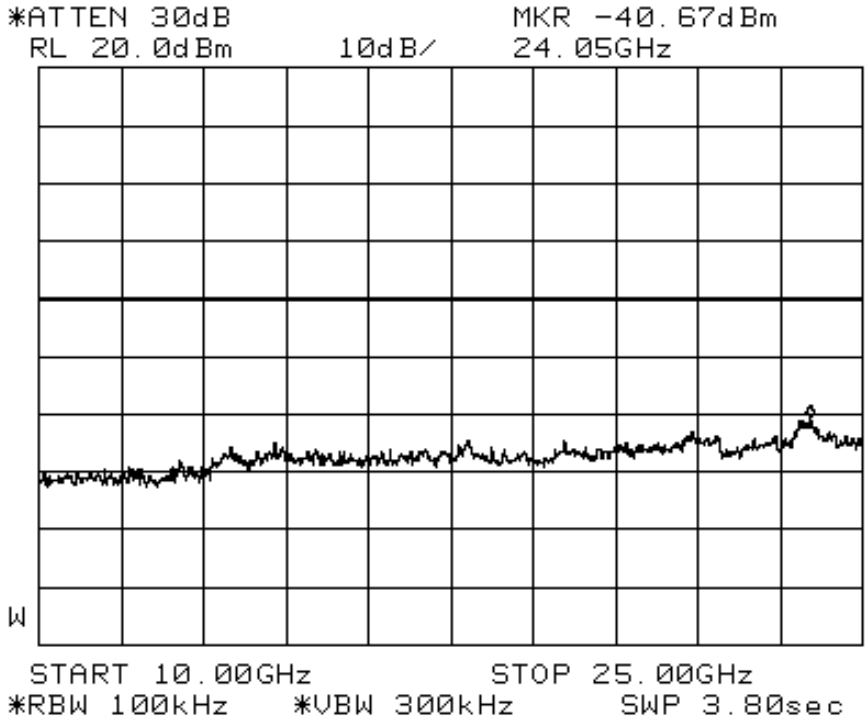


Plot 59 - Channel 7 @ 802.11b 11Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

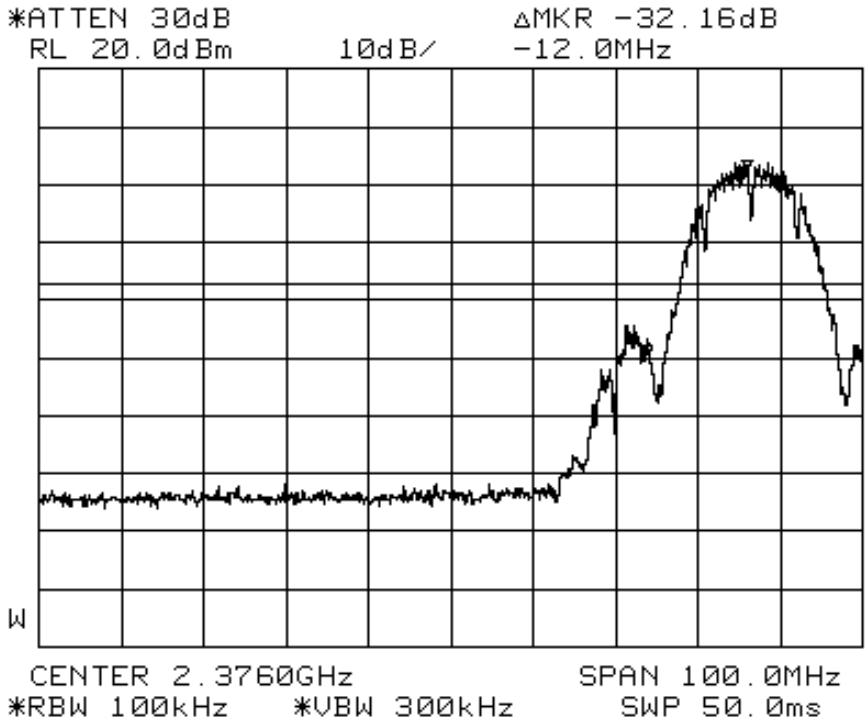


Plot 60 - Channel 13 @ 802.11b 11Mbps (30MHz-10GHz)

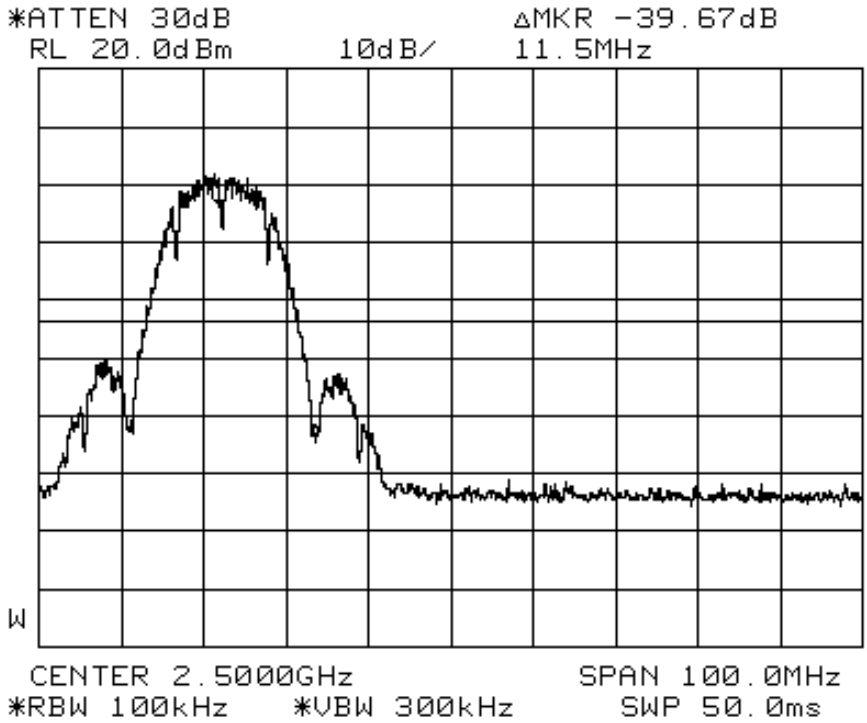


Plot 61 - Channel 13 @ 802.11b 11Mbps (10GHz-25GHz)

BAND EDGE COMPLIANCE PLOTS

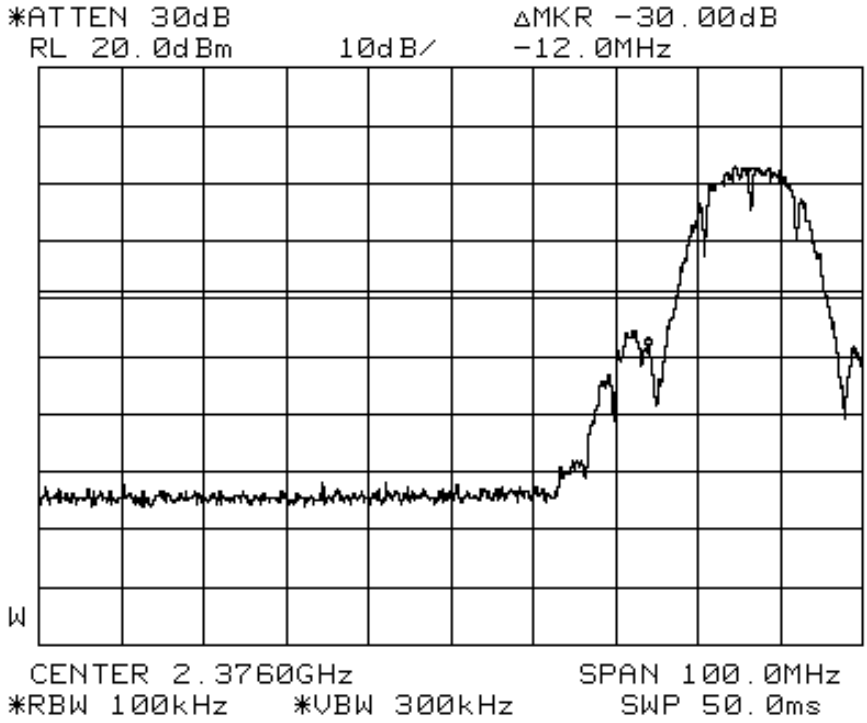


Plot 62 - Channel 1 @ 802.11b 1Mbps

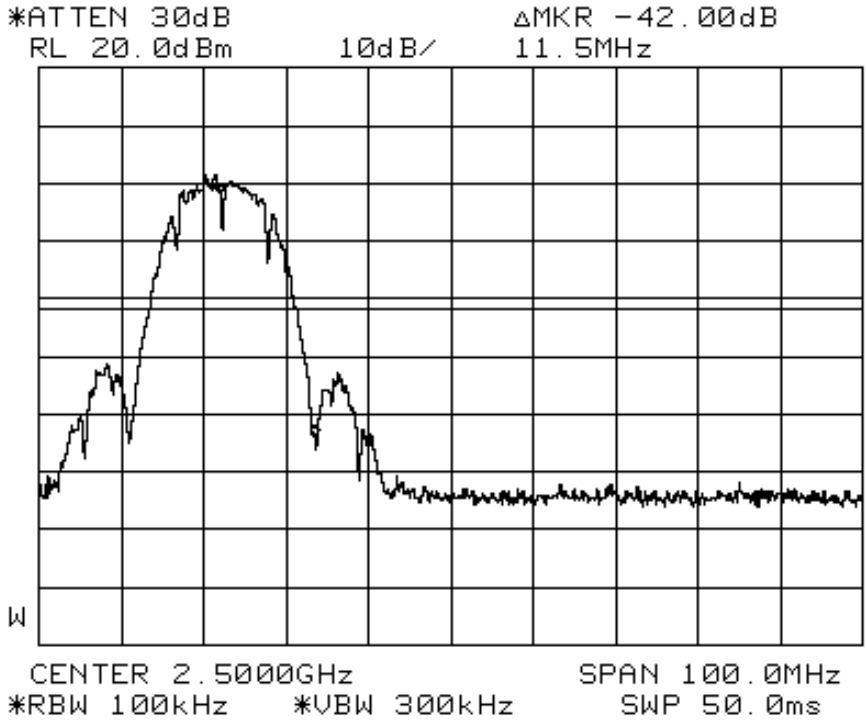


Plot 63 - Channel 13 @ 802.11b 1Mbps

BAND EDGE COMPLIANCE PLOTS

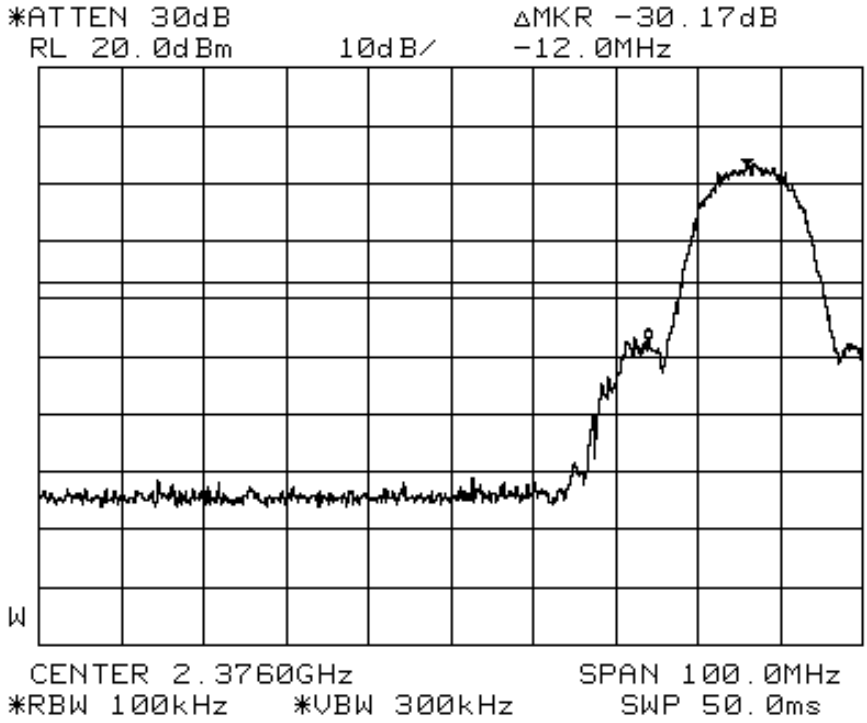


Plot 64 - Channel 1 @ 802.11b 2Mbps

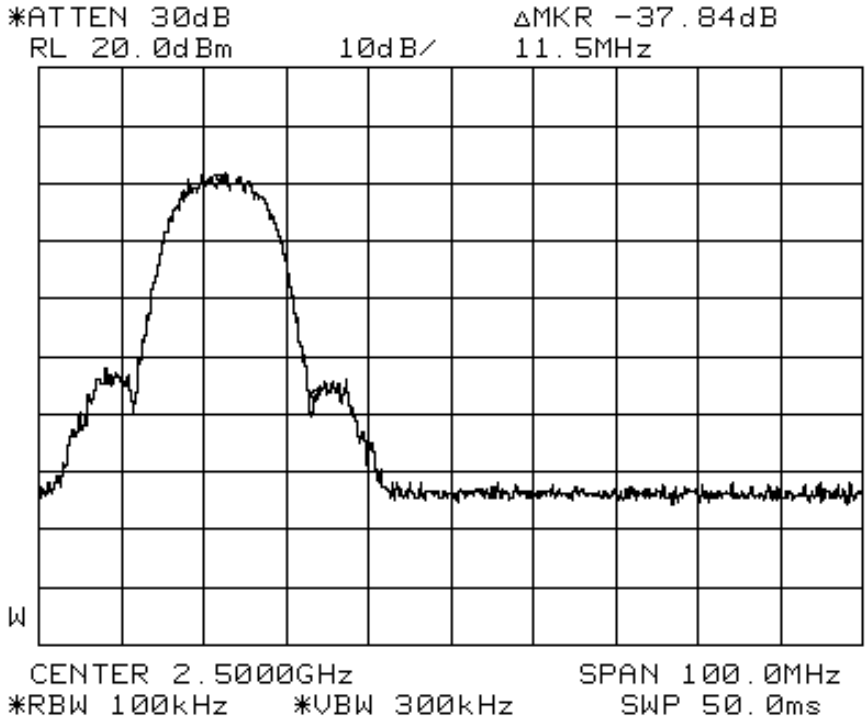


Plot 65 - Channel 13 @ 802.11b 2Mbps

BAND EDGE COMPLIANCE PLOTS

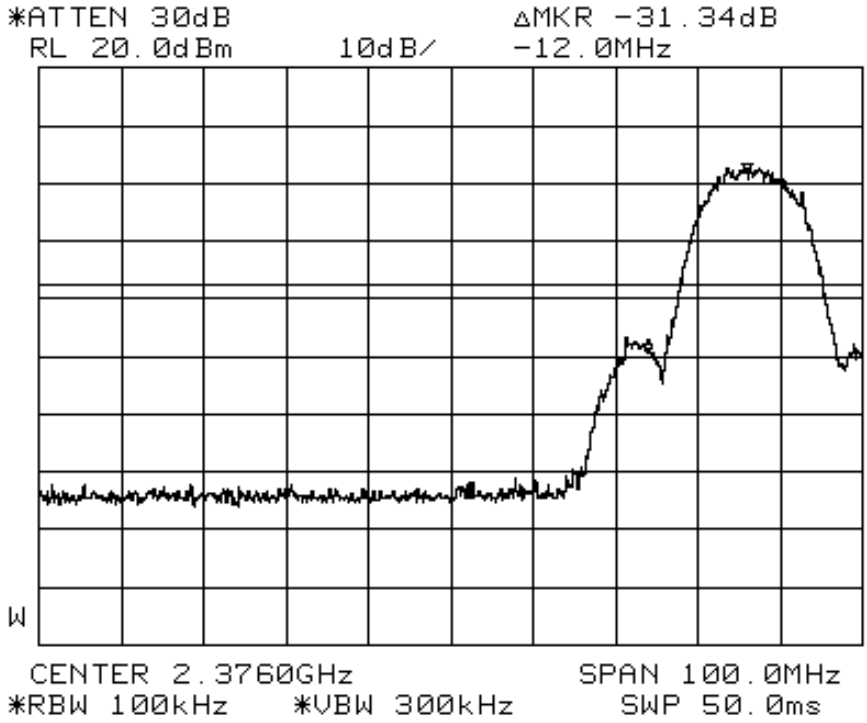


Plot 66 - Channel 1 @ 802.11b 5.5Mbps

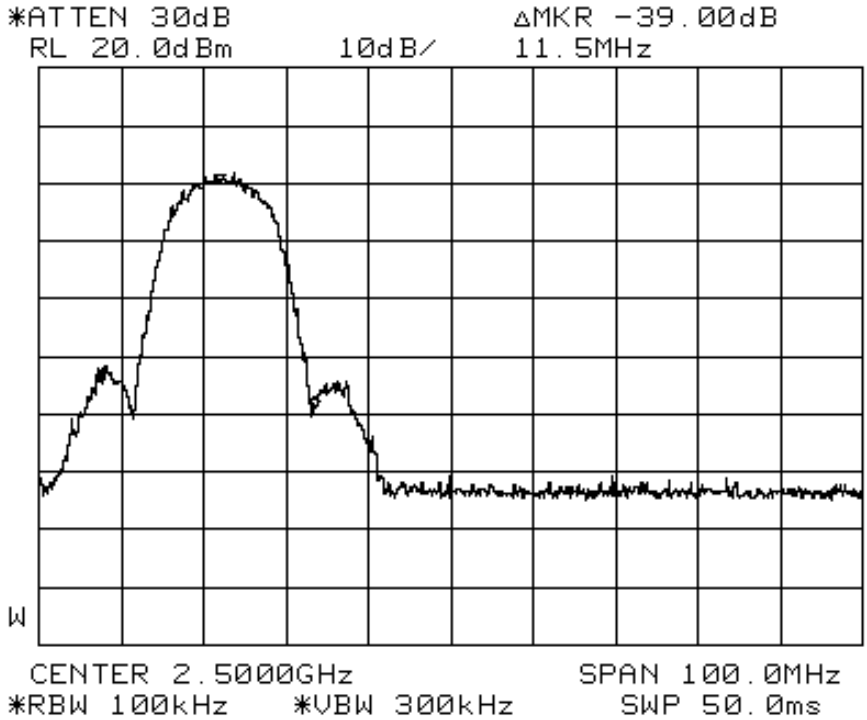


Plot 67 - Channel 13 @ 802.11b 5.5Mbps

BAND EDGE COMPLIANCE PLOTS



Plot 68 - Channel 1 @ 802.11b 11Mbps



Plot 69 - Channel 13 @ 802.11b 11Mbps

FCC Part 15C (15.247(d)) Peak Power Spectral Density Results

Operation Mode: 802.11b WLAN

The EUT shows compliance to the requirements of this section, which states the peak power spectral density of an intentional radiator (EUT) to the antenna shall not be greater than 8dBm (6.3mW) in any 3kHz band during any time interval of continuous transmission.

Data Rate: 1Mbps

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
1	2.412	0.03690	6.3
7	2.442	0.02613	6.3
13	2.472	0.02329	6.3

Data Rate: 2Mbps

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
1	2.412	0.14126	6.3
7	2.442	0.08913	6.3
13	2.472	0.07639	6.3

Data Rate: 5.5Mbps

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
1	2.412	0.11221	6.3
7	2.442	0.06808	6.3
13	2.472	0.05848	6.3

Data Rate: 11Mbps

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
1	2.412	0.12580	6.3
7	2.442	0.07944	6.3
13	2.472	0.06562	6.3

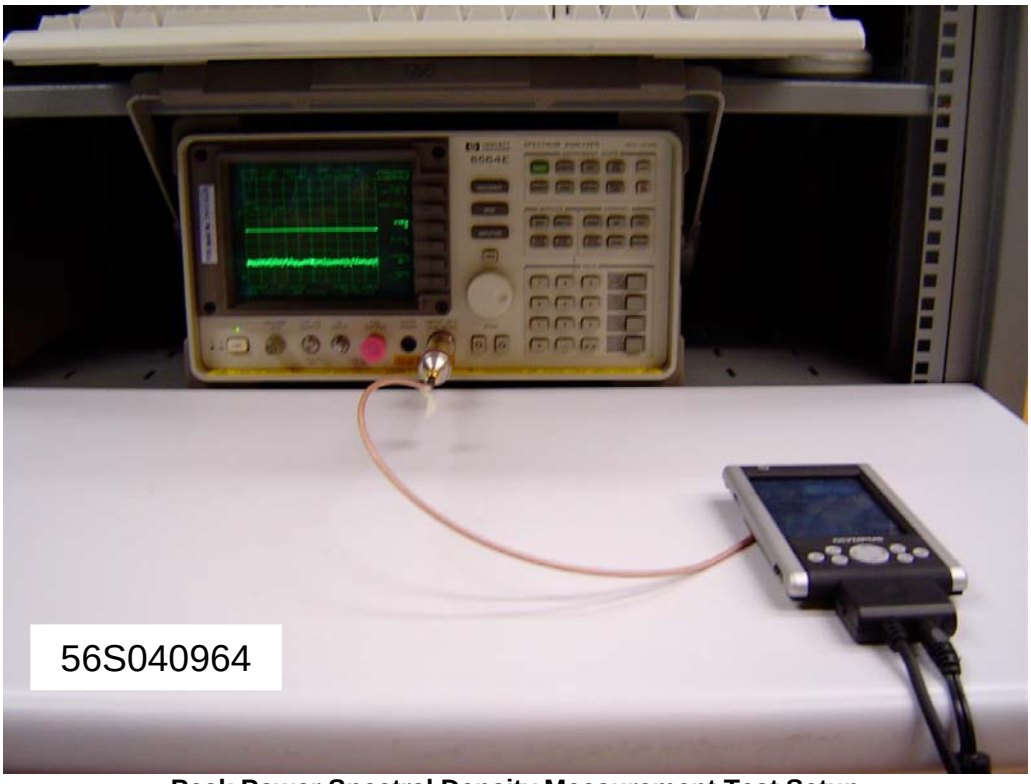
Please refer to the attached Plots 70 – 81 for details.

Tested by: DP

Notes

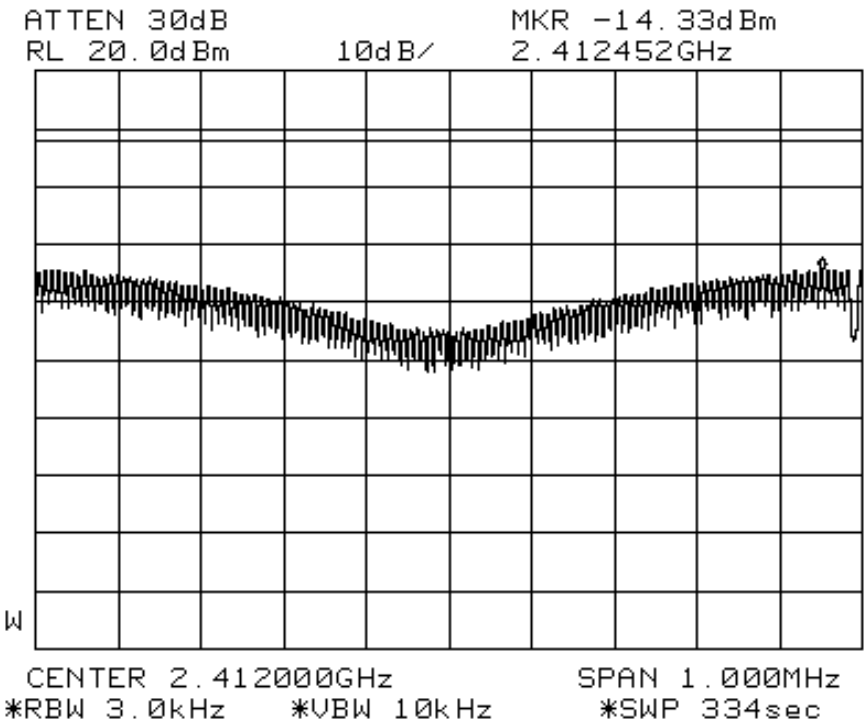
1. Environmental Conditions

Temperature	23°C
Relative Humidity	58%
Atmospheric Pressure	1030mbar

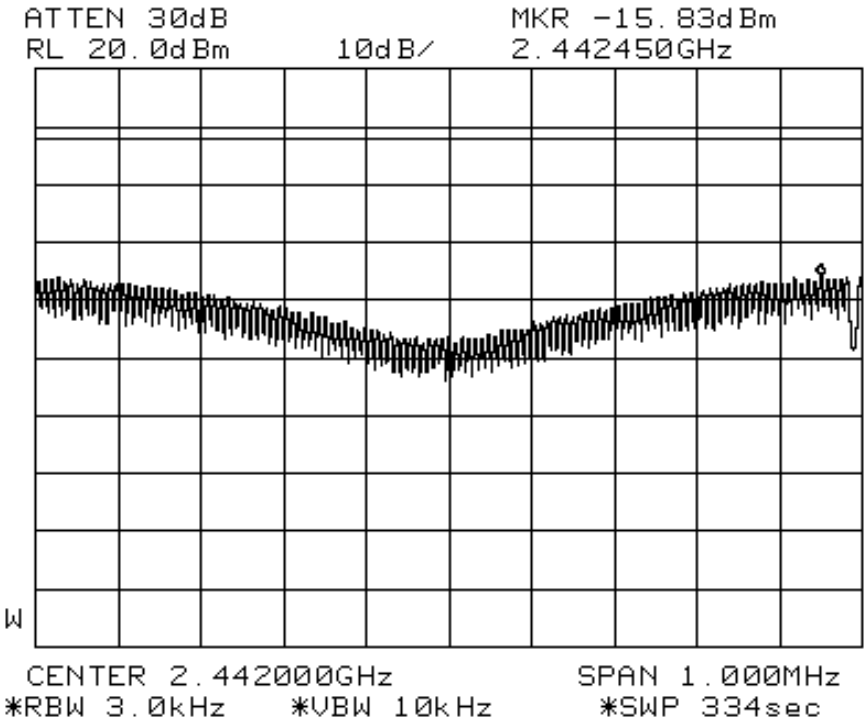


Peak Power Spectral Density Measurement Test Setup

PEAK POWER SPECTRAL DENSITY PLOTS

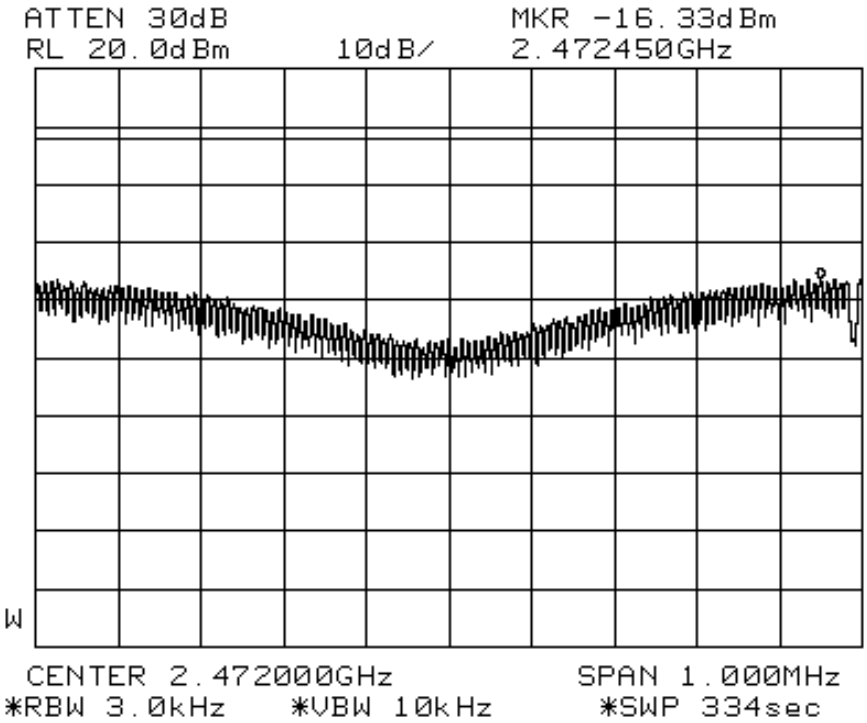


Plot 70- Channel 1 @ 802.11b 1Mbps

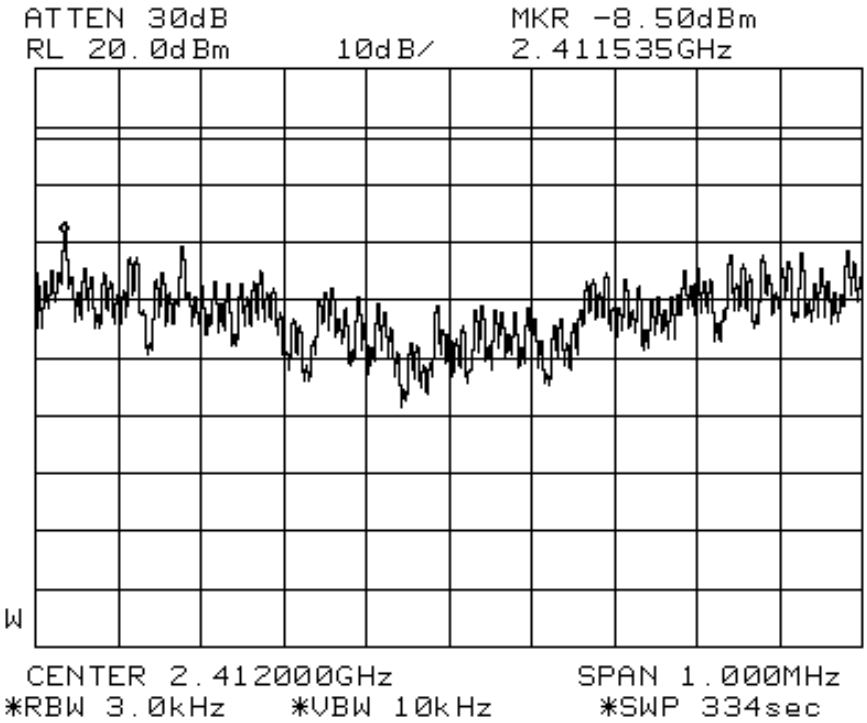


Plot 71 - Channel 7 @ 802.11b 1Mbps

PEAK POWER SPECTRAL DENSITY PLOTS

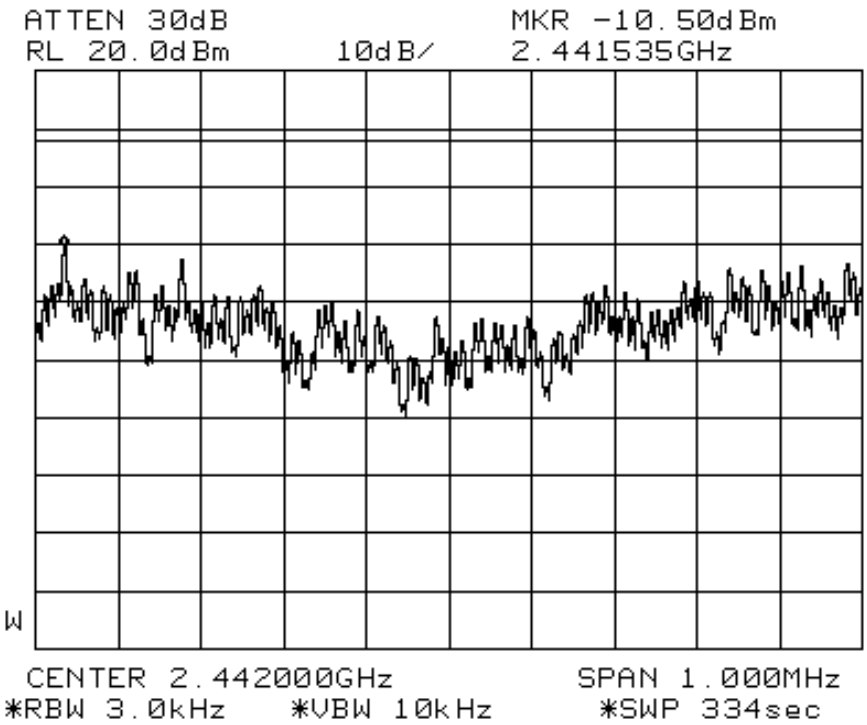


Plot 72 - Channel 13 @ 802.11b 1Mbps

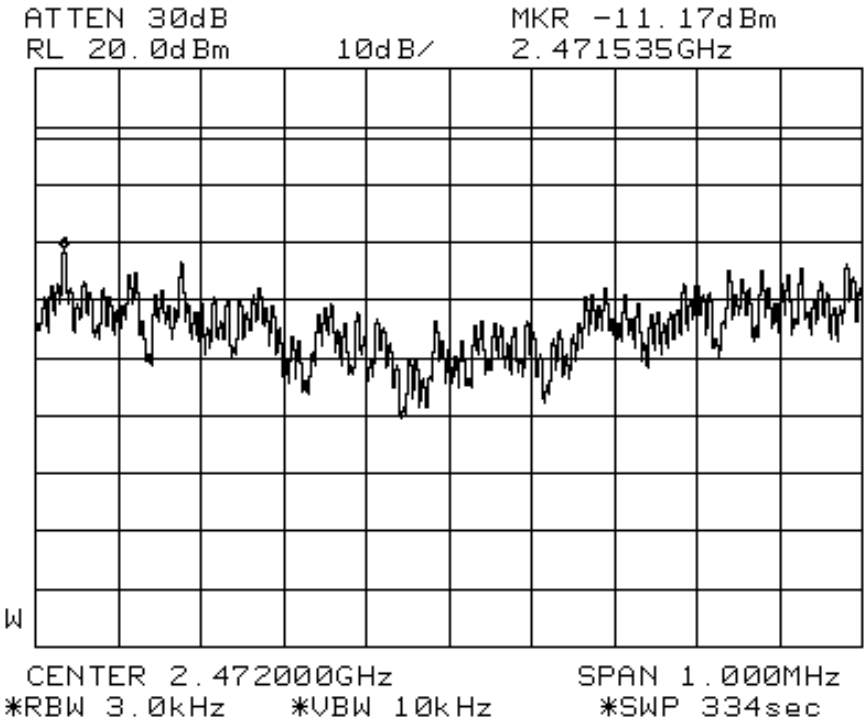


Plot 73 - Channel 1 @ 802.11b 2Mbps

PEAK POWER SPECTRAL DENSITY PLOTS

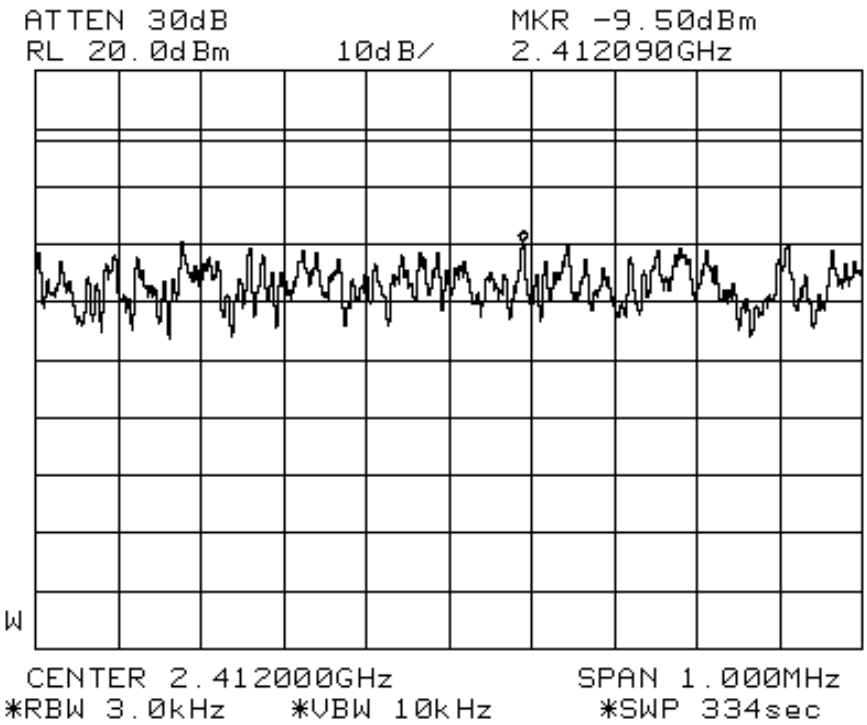


Plot 74 - Channel 7 @ 802.11b 2Mbps

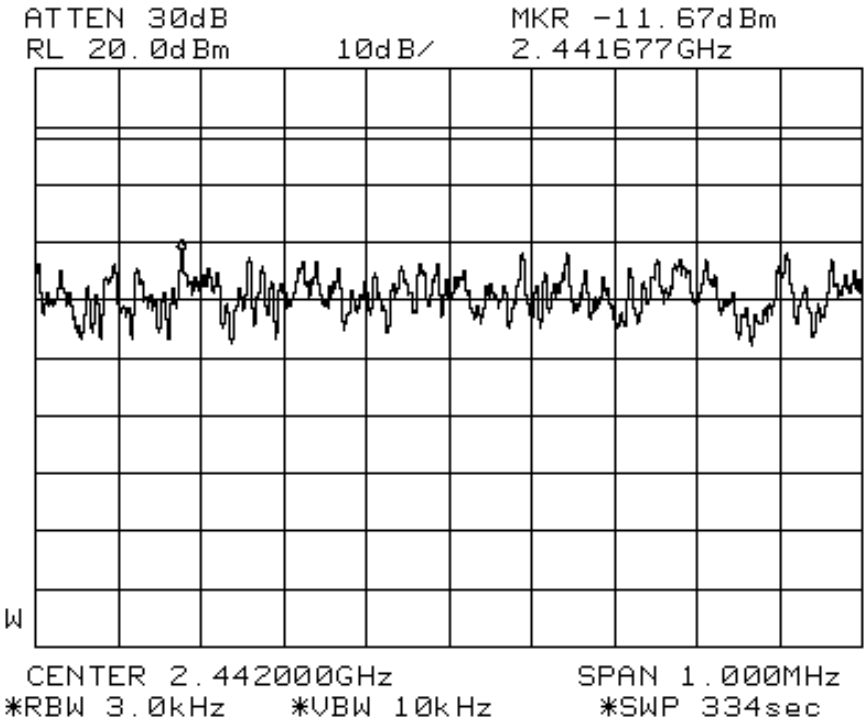


Plot 75 - Channel 13 @ 802.11b 2Mbps

PEAK POWER SPECTRAL DENSITY PLOTS

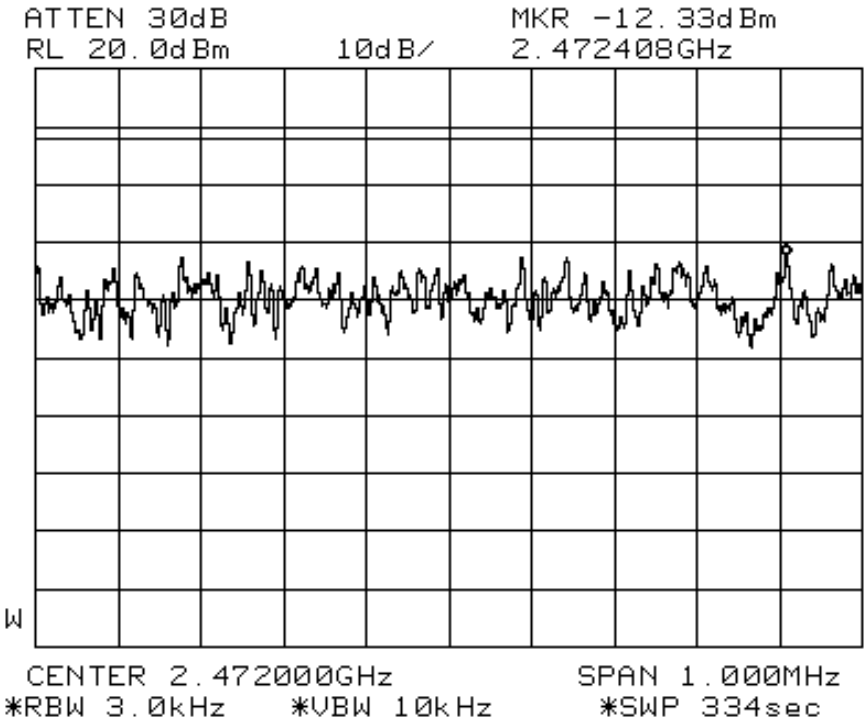


Plot 76 - Channel 1 @ 802.11b 5.5Mbps

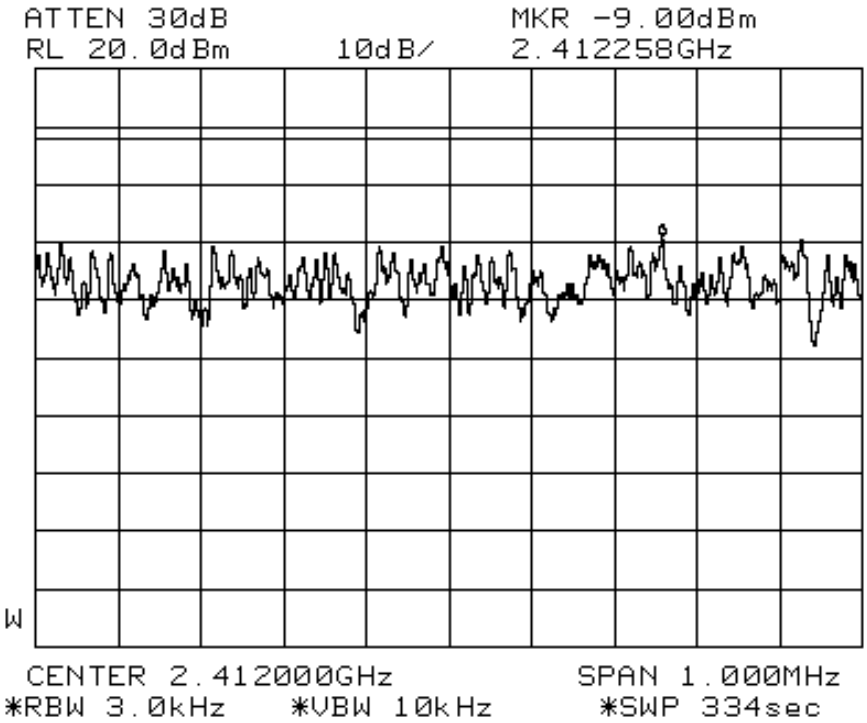


Plot 77 - Channel 7 @ 802.11b 5.5Mbps

PEAK POWER SPECTRAL DENSITY PLOTS

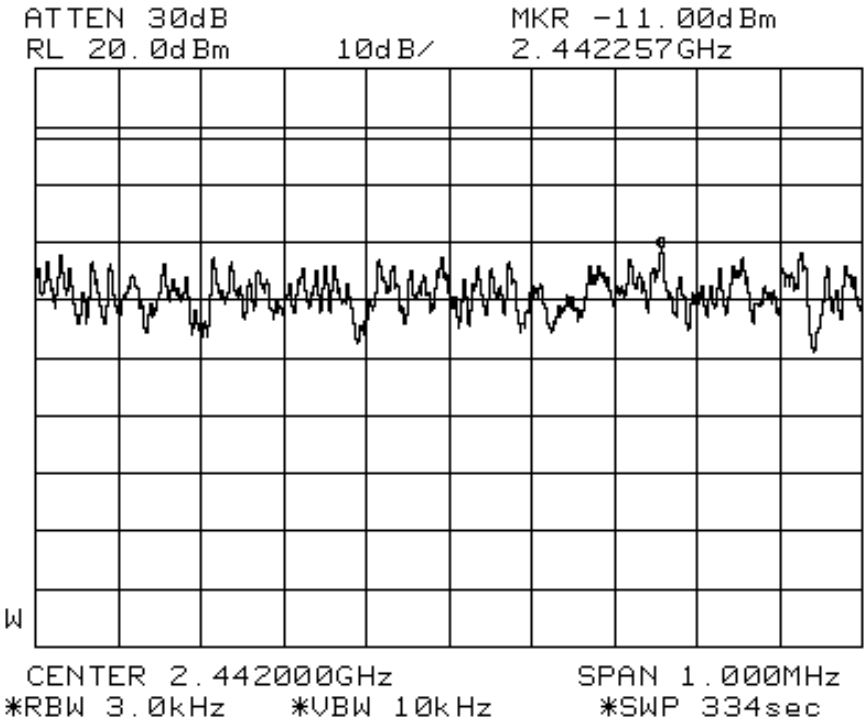


Plot 78 - Channel 13 @ 802.11b 5.5Mbps

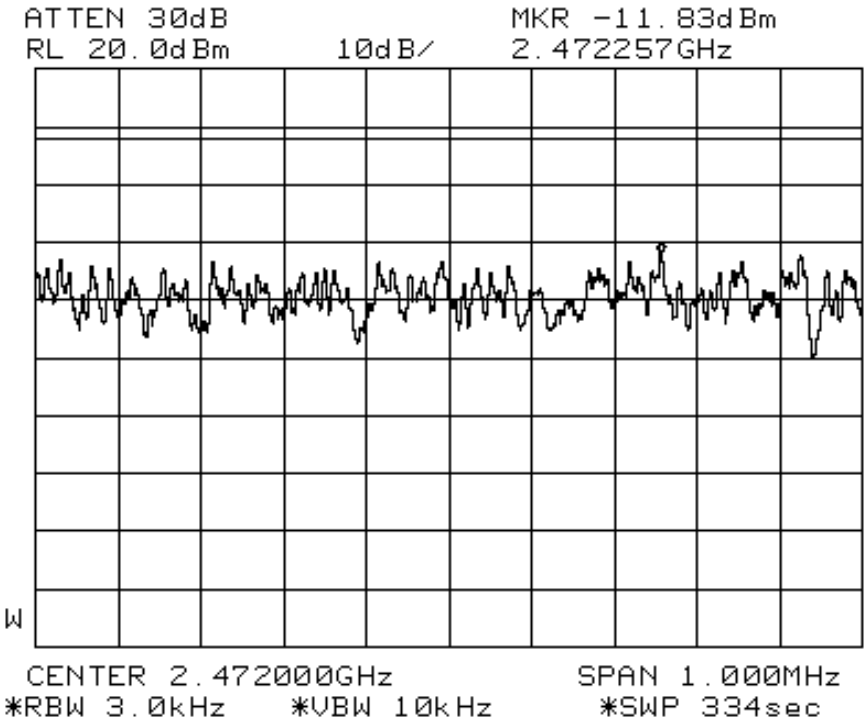


Plot 79 - Channel 1 @ 802.11b 11Mbps

PEAK POWER SPECTRAL DENSITY PLOTS



Plot 80 - Channel 7 @ 802.11b 11Mbps



Plot 81 - Channel 13 @ 802.11b 11Mbps

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August 2003

ANNEX A

TEST INSTRUMENTATION & GENERAL PROCEDURES

3m OATS Test Instrumentation
(Conducted Emissions)

Instrument	Model	S/No	Cal Due Date	
R&S Test Receiver (9kHz-30MHz)	ESH3	862301/005	25 Jul 2005	x
Schaffner Pulse Limiter	CFL 9206	1720	1 Apr 2005	x
EMCO LISN (for EUT) – LISN6	3825/2	9309-2127	20 May 2005	x

10m Anechoic Chamber Test Instrumentation (Radiated Emissions)

Instrument	Model	S/No	Cal Due Date	
Radiated Emission				
R&S Test Receiver (20Hz – 26.5GHz) – ESMI2	ESMI	829214/006 829550/001	25 Dec 2005	x
HP Preamplifier (for ESMI3, 0.01-3GHz) – PA6	87405A	3950M00353	29 Apr 2005	x
MITEQ Preamplifier (0.1-26.5GHz) – PA11	NSP2650-N	728231	16 Apr 2005	x
Schaffner Bilog Antenna – BL5	CBL6143	5041	21 May 2005	x
EMCO Horn Antenna – H14	3115	0003-6087	22 May 2005	x
Micro-tronics Band-Stop Filter	BRM50701	017	1 Apr 2005	x

Test Instrumentation
(Carrier Frequency Separation, Number of Hopping Frequencies, Spectrum Bandwidth (6dB and 20dB Bandwidth Measurement), Average Frequency Dwell Time, Maximum Peak Power, RF Conducted Spurious Emissions at the Transmitter Antenna Terminal, Band Edge Compliance at the Transmitter Antenna Terminal, Peak Power Spectral Density)

Instrument	Model	S/No	Cal Due Date	
HP Spectrum Analyzer	8563E	3846A09953	16 Dec 2005	x
R&S Universal Radio Communication Tester	CMU 200	837587/068	22 Mar 2005	x

CONDUCTED EMISSIONS TEST DESCRIPTION (BLUETOOTH & 802.11b WLAN)

Test Set-up

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.

2. The power supply for the EUT was fed through a 50Ω/50μH EUT LISN, connected to filtered mains.

3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.

4. All other supporting equipment were powered separately from another LISN.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.

2. A scan was made on the NEUTRAL line over the required frequency range using an EMI test receiver.

3. High peaks, relative to the limit line, were then selected.

4. The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10kHz. Both Quasi-peak and Average measurements were made.

5. Steps 2 to 4 were then repeated for the LIVE line.

Sample Calculation Example

At 20 MHz limit = 250 μV = 47.96 dBμV

Transducer factor of LISN, pulse limiter & cable loss at 20 MHz = 11.2 dB

Q-P reading obtained directly from EMI Receiver = 40 dBμV
(Calibrated for system losses)

Therefore, Q-P margin = 40 - 47.96 = -7.96 i.e. **7.96 dB below limit**

RADIATED EMISSIONS TEST DESCRIPTION (3m ANC) (BLUETOOTH & 802.11b WLAN)

Test Set-up

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table.

2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.

3. The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.

2. A prescan was carried out to find out the EUT highest emissions relative to the limit by rotating the EUT through three orthogonal axes to determine which attitude and equipment arrangement produces such emissions.

3. The final measurement was then carried out at the selected frequency points based on the highest emissions arrangement found from step 2. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:

   a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
   b. The EUT was then rotated to the direction that gave the maximum emission.
   c. Finally, the antenna height was adjusted to the height that gave the maximum emission.

4. A Quasi-peak measurement was made for that frequency point if it was less than or equal to 1GHz. For frequency point that above 1GHz, both Peak and Average measurements were carried out.

5. Steps 3 and 4 were repeated for the next frequency point, until all selected frequency points were measured.

6. The frequency range covered was from 30MHz to 25GHz, using the Bi-log antenna for frequencies from 30MHz up to 3GHz, and the Horn antenna above 3GHz.

Sample Calculation Example

At 300 MHz limit = 200 μV/m = 46 dBμV/m

Log-periodic antenna factor & cable loss at 300 MHz = 18.511 dB

Q-P reading obtained directly from EMI Receiver = 40 dBμV/m
(Calibrated level including antenna factors & cable losses)

Therefore, Q-P margin = 40 - 46 = -6 i.e. **6 dB below limit**

CARRIER FREQUENCY SEPARATION TEST DESCRIPTION (BLUETOOTH)

Test Set-up

1. The EUT and supporting equipment were set up as shown in test setup photo; accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.

2. The power supply for the EUT was connected to a filtered mains.

3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz.

5. All other supporting equipment were powered separately from another filtered mains.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the Bluetooth test mode with hopping sequence on.

2. The start and stop frequencies of the spectrum analyser were set to 2.401GHz and 2.404GHz with frequency sweeping set to 50ms.

3. The spectrum analyser was set to max hold to capture the two adjacent transmitting frequencies within the span. The signal capturing was continuous until no further signals were detected.

4. The carrier frequency separation of the two adjacent transmitting / operating frequency was measured by finding the carrier frequency difference between the two adjacent channels.

5. The steps 2 to 4 were repeated with the following start and stop frequencies settings:
   a. 2.439GHz to 2.442GHz
   b. 2.440GHz to 2.443GHz
   c. 2.478GHz to 2.481GHz

SPECTRUM BANDWIDTH (20dB BANDWIDTH MEASUREMENT) TEST DESCRIPTION (BLUETOTH)

Test Set-up

1. The EUT and supporting equipment were set up as shown in test setup photo; accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.

2. The power supply for the EUT was connected to a filtered mains.

3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 10kHz and 100kHz.

5. All other supporting equipment were powered separately from another filtered mains.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the Bluetooth test mode, non-hopping with transmitting frequency at Channel 0 (2.402GHz).

2. The center frequency of the spectrum analyser was set to the transmitting frequency with the frequency span wide enough to capture the 20dB bandwidth of the transmitting frequency.

3. The spectrum analyser was set to max hold to capture the transmitting frequency. The signal capturing was continuous until no further changes were observed.

4. The peak of the transmitting frequency was detected with the marker peak function of the spectrum analyser. The frequencies below the 20dB peak frequency at lower (f_L) and upper (f_H) sides of the transmitting frequency were marked and measured by using the marker-delta function of the spectrum analyser.

6. The 20dB bandwidth of the transmitting frequency is the frequency difference between the marked lower and upper frequencies, $| f_H – f_L |$.

7. The steps 2 to 5 were repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.

NUMBER OF HOPPING FREQUENCIES TEST DESCRIPTION (BLUETOOTH)

Test Set-up

1. The EUT and supporting equipment were set up as shown in test setup photo; accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.

2. The power supply for the EUT was connected to a filtered mains.

4. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 300kHz and 1MHz.

5. All other supporting equipment were powered separately from another filtered mains.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the Bluetooth test mode with hopping sequence on.

2. The start and stop frequencies of the spectrum analyser were set to 2.40GHz and 2.421GHz with frequency sweeping set to 50ms.

3. The spectrum analyser was set to max hold to capture all the transmitting frequencies within the span. The signal capturing was continuous until all the transmitting frequencies were captured and no further signals were detected.

4. The numbers of transmitting frequencies were counted and recorded.

5. The steps 2 to 5 were repeated with the following start and stop frequencies settings:

   a. 2.420GHz to 2.441GHz
   b. 2.440GHz to 2.461GHz
   c. 2.460GHz to 2.4835GHz

6. The total number of hopping frequencies is the sum of the number of the hopping frequencies found for each span.

AVERAGE FREQUENCY DWELL TIME TEST DESCRIPTION (BLUETOOTH)

Test Set-up

1. The EUT and supporting equipment were set up as shown in test setup photo; accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.

2. The power supply for the EUT was connected to a filtered mains.

3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 1MHz and 3MHz.

5. All other supporting equipment were powered separately from another filtered mains.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the Bluetooth test mode, hopping sequence on.

2. The center frequency of the spectrum analyser was set to 2.402GHz with zero frequency span (spectrum analyser acts as an oscilloscope).

3. The sweep time of the spectrum analyser was adjusted until a stable signal can be seen on the spectrum analyser.

4. The duration (dwell time) of a packet was measured using the marker-delta function of the spectrum analyser. The average dwell time of the transmitting frequency was computed as below:

Average Frequency Dwell Time	=	measured time slot length (l) x hopping rate (h) / number of hopping frequencies x 30 seconds period
where EUT hopping rate	=	1600 hops/data packet length/s
Number of EUT hopping frequencies	=	79 hops

5. The steps 2 to 4 were repeated with the center frequency of the spectrum analyser were set to 2.441GHz and 2.480GHz respectively.

MAXIMUM PEAK POWER TEST DESCRIPTION (BLUETOOTH)

Test Set-up

1. The EUT and supporting equipment were set up as shown in test setup photo; accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.

2. The power supply for the EUT was connected to a filtered mains.

3. The RF antenna connector was connected to the Universal Radio Communication Tester, which set into power analyser mode via a low-loss coaxial cable.

4. All other supporting equipment were powered separately from another filtered mains.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the Bluetooth test mode, non-hopping with transmitting frequency at Channel 0 (2.402GHz).

2. The maximum peak power of the transmitting frequency was detected and recorded.

3. The step 2 was repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.

RF CONDUCTED SPURIOUS EMISSIONS AT THE TRANSMITTER ANTENNA TERMINAL TEST DESCRIPTION (BLUETOOTH)

Test Set-up

1. The EUT and supporting equipment were set up in a shielded enclosure; accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.

2. The power supply for the EUT was connected to a filtered mains.

3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz.

5. All other supporting equipment were powered separately from another filtered mains.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the Bluetooth test mode, non-hopping with transmitting frequency at Channel 0 (2.402GHz).

2. The start and stop frequencies of the spectrum analyser were set to 30MHz and 10GHz.

3. The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.

4. The steps 2 to 3 were repeated with frequency span was set from 10GHz to 25GHz.

5. The steps 2 to 4 were repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.

BAND EDGE COMPLIANCE AT THE TRANSMITTER ANTENNA TERMINAL TEST DESCRIPTION (BLUETOOTH)

Test Set-up

1. The EUT and supporting equipment were set up as shown in test setup photo; accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.

2. The power supply for the EUT was connected to a filtered mains.

3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz.

5. All other supporting equipment were powered separately from another filtered mains.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the Bluetooth test mode, hopping sequence on.

2. The frequency span of the spectrum analyser was set to wide enough to capture the lower band edge of the Bluetooth band, 2.40GHz and any spurious emissions at the band edge.

3. The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.

4. The steps 2 to 3 were repeated with the frequency span of the spectrum analyser was set to wide enough to capture the upper band edge frequency of the Bluetooth band, 2.4835GHz and the any spurious emissions at the band-edge.

PEAK POWER SPECTRAL DENSITY TEST DESCRIPTION (BLUETOOTH)

Test Set-up

1. The EUT and supporting equipment were set up in a shielded enclosure; accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.

2. The power supply for the EUT was connected to a filtered mains.

3. The RF antenna connector was connected to the spectrum via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 3kHz and 10kHz.

5. All other supporting equipment were powered separately from another filtered mains.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the Bluetooth test mode, non-hopping with transmitting frequency at Channel 0 (2.402GHz).

2. The sweep time of the spectrum analyser was set to the value of the ratio of the frequency span divided by the RBW.

3. The peak power density of the transmitting frequency was detected and recorded.

4. The steps 1 to 3 were repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST DESCRIPTION (802.11b WLAN)

Test Set-up

1. The EUT and supporting equipment were set up as shown in test setup photo; accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.

2. The power supply for the EUT was connected to a filtered mains.

3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz.

5. All other supporting equipment were powered separately from another filtered mains.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in continuous transmitting at Channel 1 (2.412GHz) with DBPSK modulation at 1Mbps, i.e. 802.11b 1Mbps operating condition.

2. The center frequency of the spectrum analyser was set to the transmitting frequency with the frequency span wide enough to capture the 6dB bandwidth of the transmitting frequency.

3. The spectrum analyser was set to max hold to capture the transmitting frequency. The signal capturing was continuous until no further changes were observed.

4. The peak of the transmitting frequency was detected with the marker peak function of the spectrum analyser. The frequencies below the 6dB peak frequency at lower (f_L) and upper (f_H) sides of the transmitting frequency were marked and measured by using the marker-delta function of the spectrum analyser.

5. The 6dB bandwidth of the transmitting frequency is the frequency difference between the marked lower and upper frequencies, $| f_H – f_L |$.

6. The steps 1 to 5 were repeated with the transmitting frequency was set to Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with modulation remains, i.e DBPSK modulation at 1Mbps under 802.11b operating condition.

7. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz), Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with DQPSK modulation at 2Mbps, i.e. 802.11b 2Mbps operating condition.

8. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz), Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with CCK modulation at 5.5Mbps and 11Mbps, i.e. 802.11b 5Mbps and 802.11b 11Mbps operating conditions.

MAXIMUM PEAK POWER TEST DESCRIPTION (802.11b WLAN)

Test Set-up

1. The EUT and supporting equipment were set up as shown in test setup photo; accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.

2. The power supply for the EUT was connected to a filtered mains.

3. The RF antenna connector was connected to the Universal Radio Communication Tester, which set into power analyser mode via a low-loss coaxial cable.

4. All other supporting equipment were powered separately from another filtered mains.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in continuous transmitting at Channel 1 (2.412GHz) with DBPSK modulation at 1Mbps, i.e. 802.11b 1Mbps operating condition.

2. The maximum peak power of the transmitting frequency was detected and recorded.

3. The steps 1 to 2 were repeated with the transmitting frequency was to Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with modulation remains, i.e DBPSK modulation at 1Mbps under 802.11b operating condition.

4. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz), Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with DQPSK modulation at 2Mbps, i.e. 802.11b 2Mbps operating condition.

5. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz), Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with CCK modulation at 5.5Mbps and 11Mbps, i.e. 802.11b 5.5Mbps and 802.11b 11Mbps operating conditions.

RF CONDUCTED SPURIOUS EMISSIONS AT THE TRANSMITTER ANTENNA TERMINAL TEST DESCRIPTION (802.11b WLAN)

Test Set-up

1. The EUT and supporting equipment were set up as shown in test setup photo; accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.

2. The power supply for the EUT was connected to a filtered mains.

3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz.

5. All other supporting equipment were powered separately from another filtered mains.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in continuous transmitting at Channel 1 (2.412GHz) with DBPSK modulation at 1Mbps, i.e. 802.11b 1Mbps operating condition.

2. The start and stop frequencies of the spectrum analyser were set to 30MHz and 10GHz.

3. The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.

4. The steps 2 to 3 were repeated with frequency span was set from 10GHz to 25GHz.

5. The steps 1 to 4 were repeated with the transmitting frequency was to Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with modulation remains, i.e DBPSK modulation at 1Mbps under 802.11b operating condition.

6. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz), Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with DQPSK modulation at 2Mbps, i.e. 802.11b 2Mbps operating condition.

7. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz), Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with CCK modulation at 5.5Mbps and 11Mbps, i.e. 802.11b 5.5Mbps and 802.11b 11Mbps operating conditions.

BAND EDGE COMPLIANCE AT THE TRANSMITTER ANTENNA TERMINAL TEST DESCRIPTION (802.11b WLAN)

Test Set-up

1. The EUT and supporting equipment were set up as shown in test setup photo; accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.

2. The power supply for the EUT was connected to a filtered mains.

3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz.

5. All other supporting equipment were powered separately from another filtered mains.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in continuous transmitting at Channel 1 (2.412GHz) with DBPSK modulation at 1Mbps, i.e. 802.11b 1Mbps operating condition.

2. The frequency span of the spectrum analyser was set to wide enough to capture the lower band edge of the allowable transmission band (2.40GHz) and any spurious emissions at the band edge.

3. The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.

4. Set the EUT to continuous transmit at Channel 13 (2.472GHz) with the same modulation.

5. The steps 2 to 3 were repeated with the frequency span of the spectrum analyser was set to wide enough to capture the upper band edge frequency of the allowable transmission band (2.4835GHz) and any spurious emissions at the band-edge.

6. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz) and Channel 13 (2.472GHz) respectively with DQPSK modulation at 2Mbps, i.e. 802.11b 2Mbps operating condition.

7. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz) and Channel 13 (2.472GHz) respectively with CCK modulation at 5.5Mbps and 11Mbps, i.e. 802.11b 5.5Mbps and 802.11b 11Mbps operating condition.

PEAK POWER SPECTRAL DENSITY TEST DESCRIPTION (802.11b WLAN)

Test Set-up

1. The EUT and supporting equipment were set up as shown in test setup photo; accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.

2. The power supply for the EUT was connected to a filtered mains.

3. The RF antenna connector was connected to the spectrum via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 3kHz and 10kHz.

5. All other supporting equipment were powered separately from another filtered mains.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in continuous transmitting at Channel 1 (2.412GHz) with DBPSK modulation at 1Mbps, i.e. 802.11b 1Mbps operating condition.

2. The sweep time of the spectrum analyser was set to the value of the ratio of the frequency span divided by the RBW.

3. The peak power density of the transmitting frequency was detected and recorded.

4. The steps 1 to 3 were repeated with the transmitting frequency was set to Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with modulation remains, i.e DBPSK modulation at 1Mbps under 802.11b operating condition.

5. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz), Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with DQPSK modulation at 2Mbps, i.e. 802.11b 2Mbps operating condition.

6. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz), Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with CCK modulation at 5.5Mbps and 11Mbps, i.e. 802.11b 5.5Mbps and 802.11b 11Mbps operating conditions.

ANNEX B

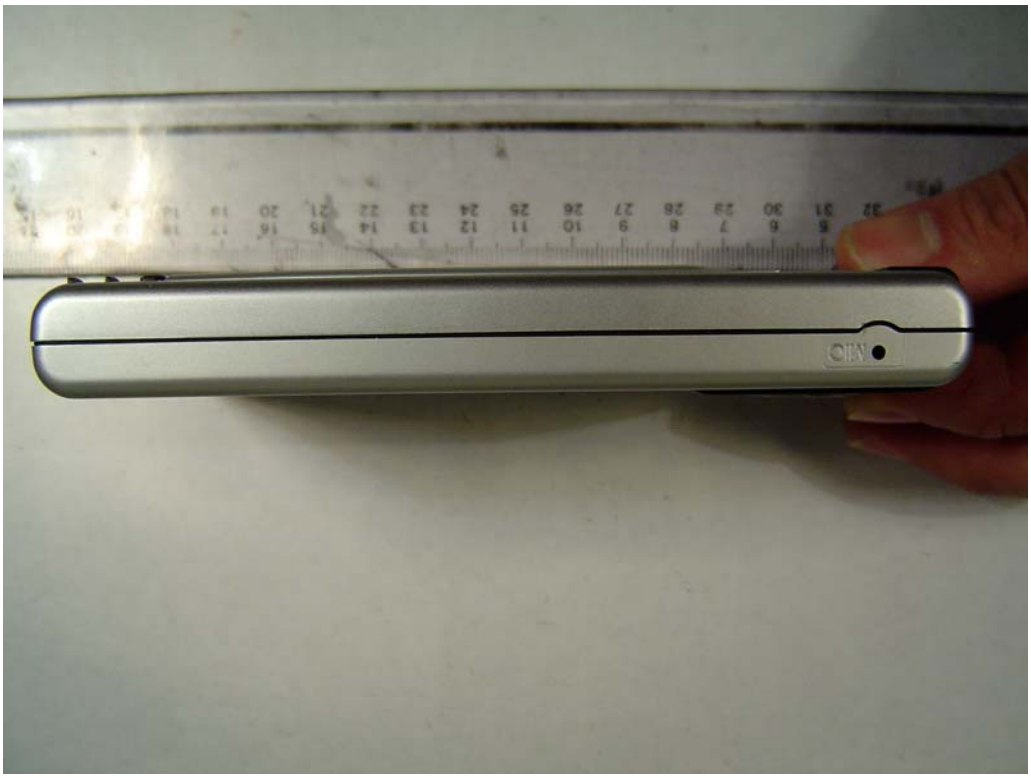
TEST PHOTOGRAPHS / DIAGRAMS

EUT PHOTOGRAPHS

EUT Front View

EUT Rear View

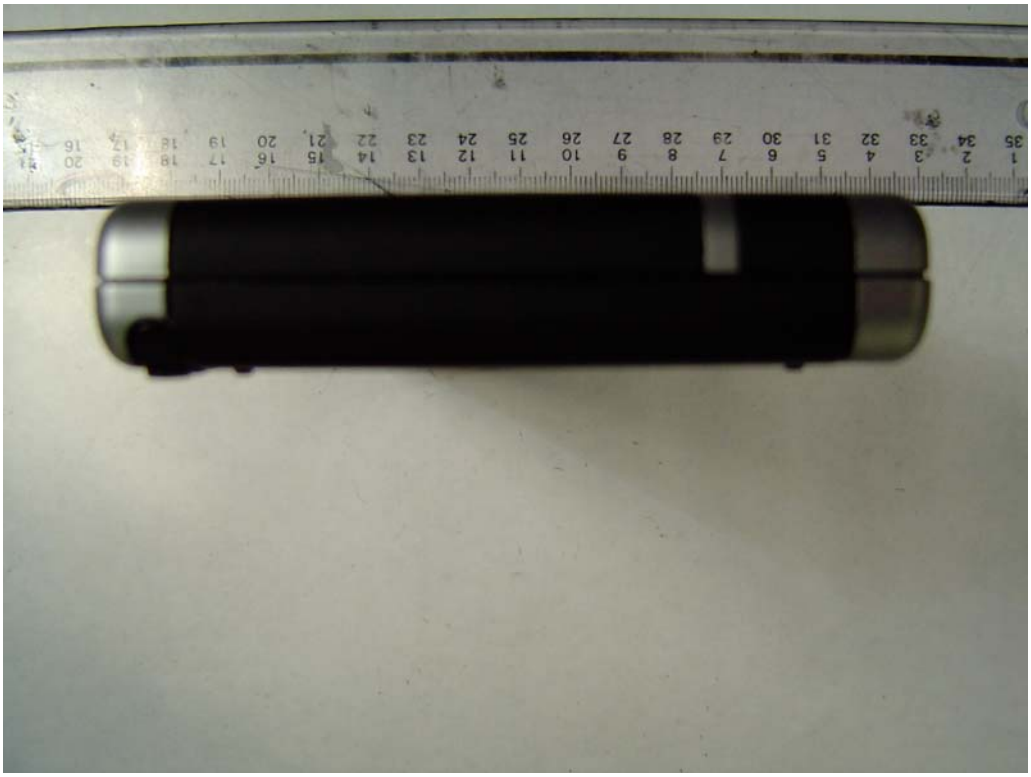
EUT PHOTOGRAPHS



EUT Left View

EUT Right View

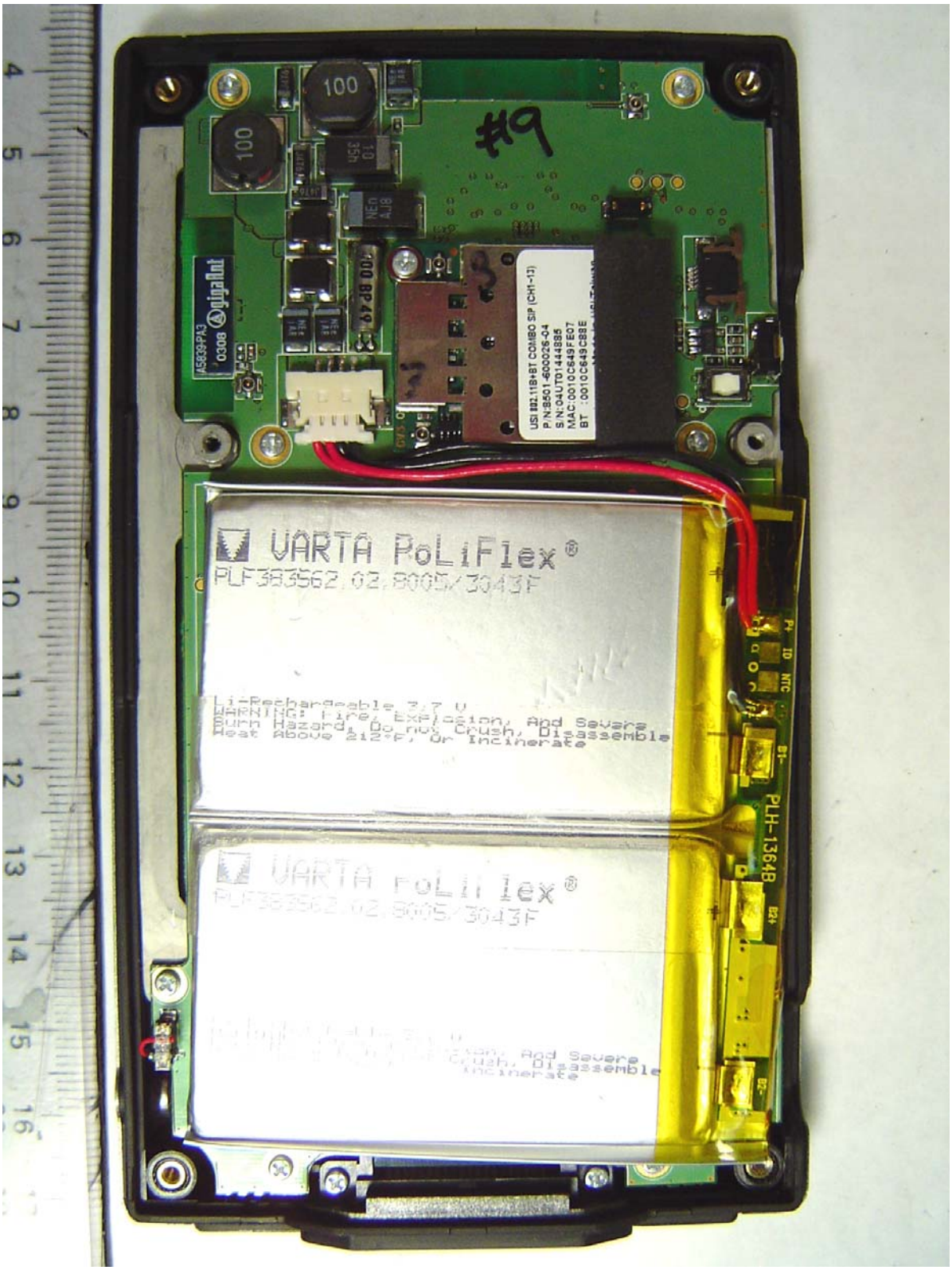
EUT PHOTOGRAPHS



EUT Top View

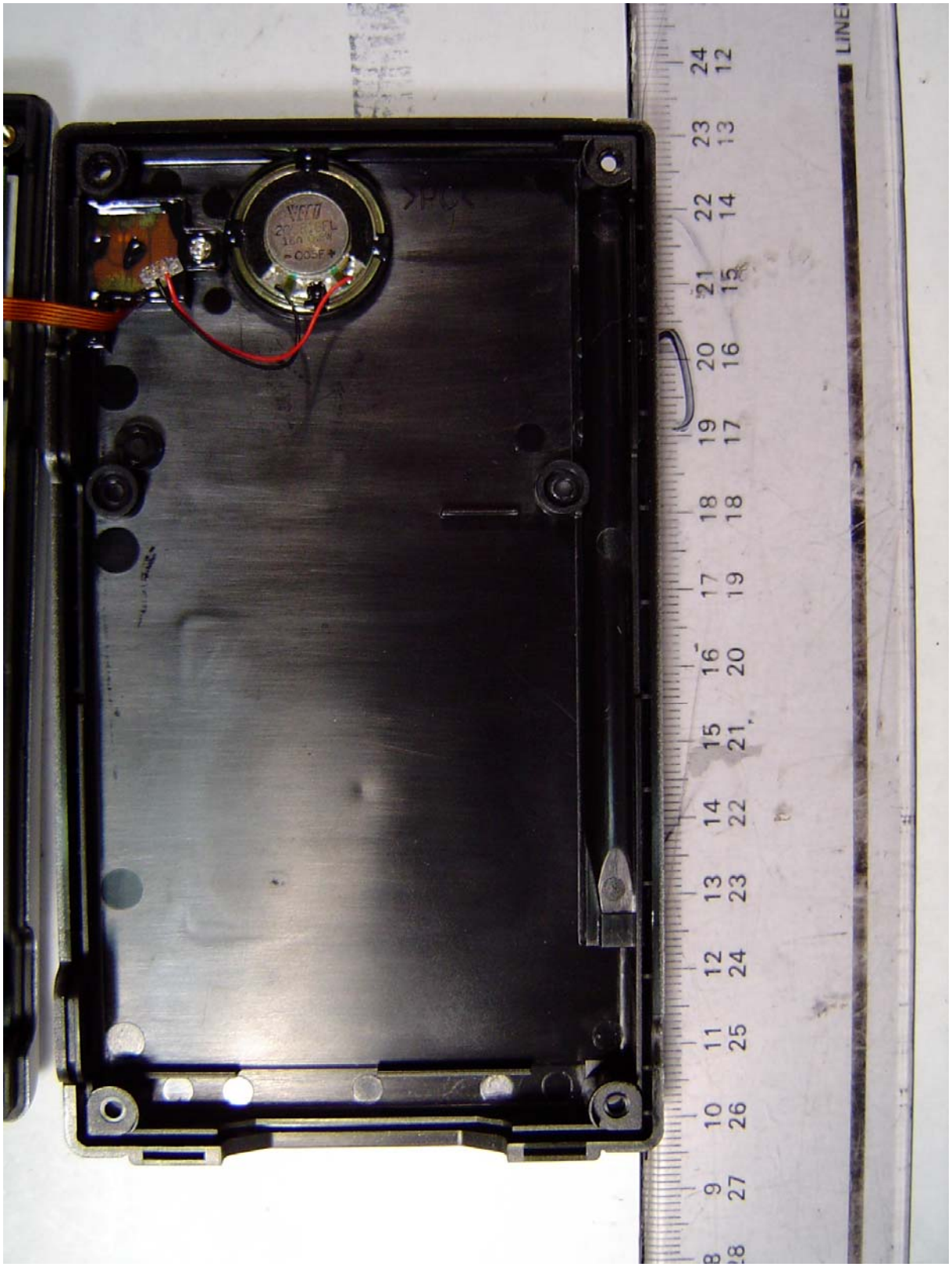
EUT Bottom View

EUT PHOTOGRAPHS

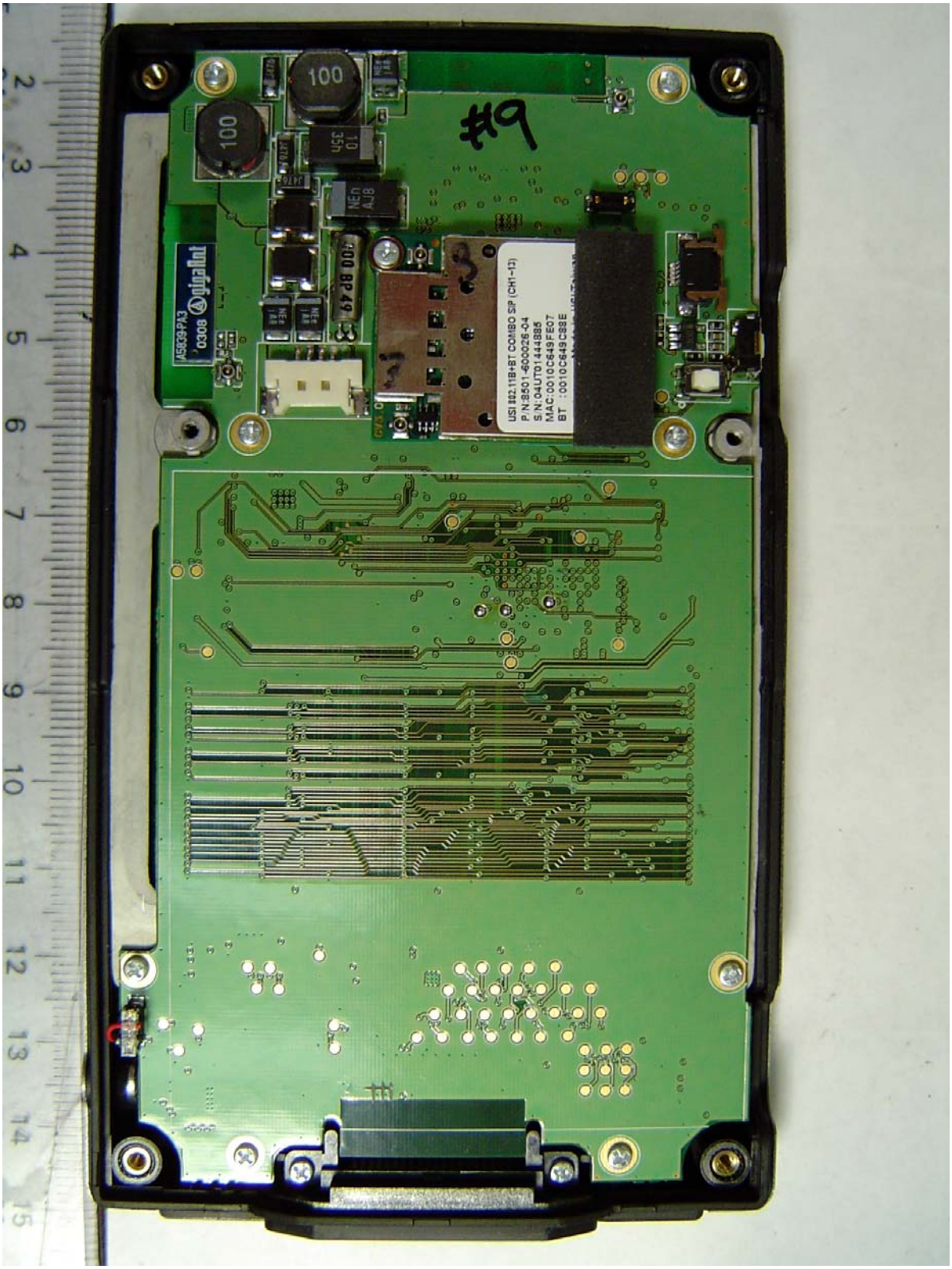


EUT Rear View (Rear Cover Removed)

EUT PHOTOGRAPHS

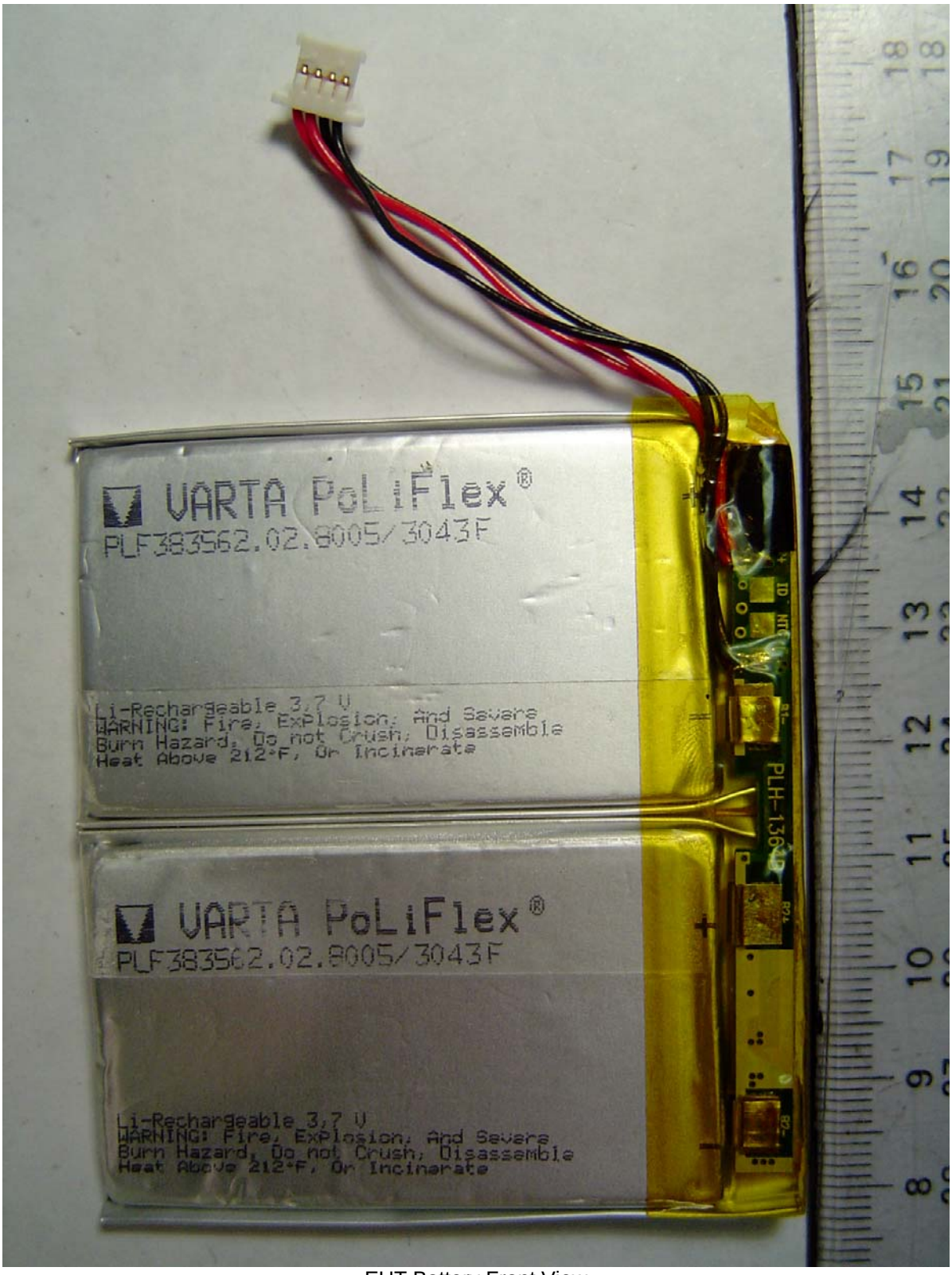


EUT Rear Cover



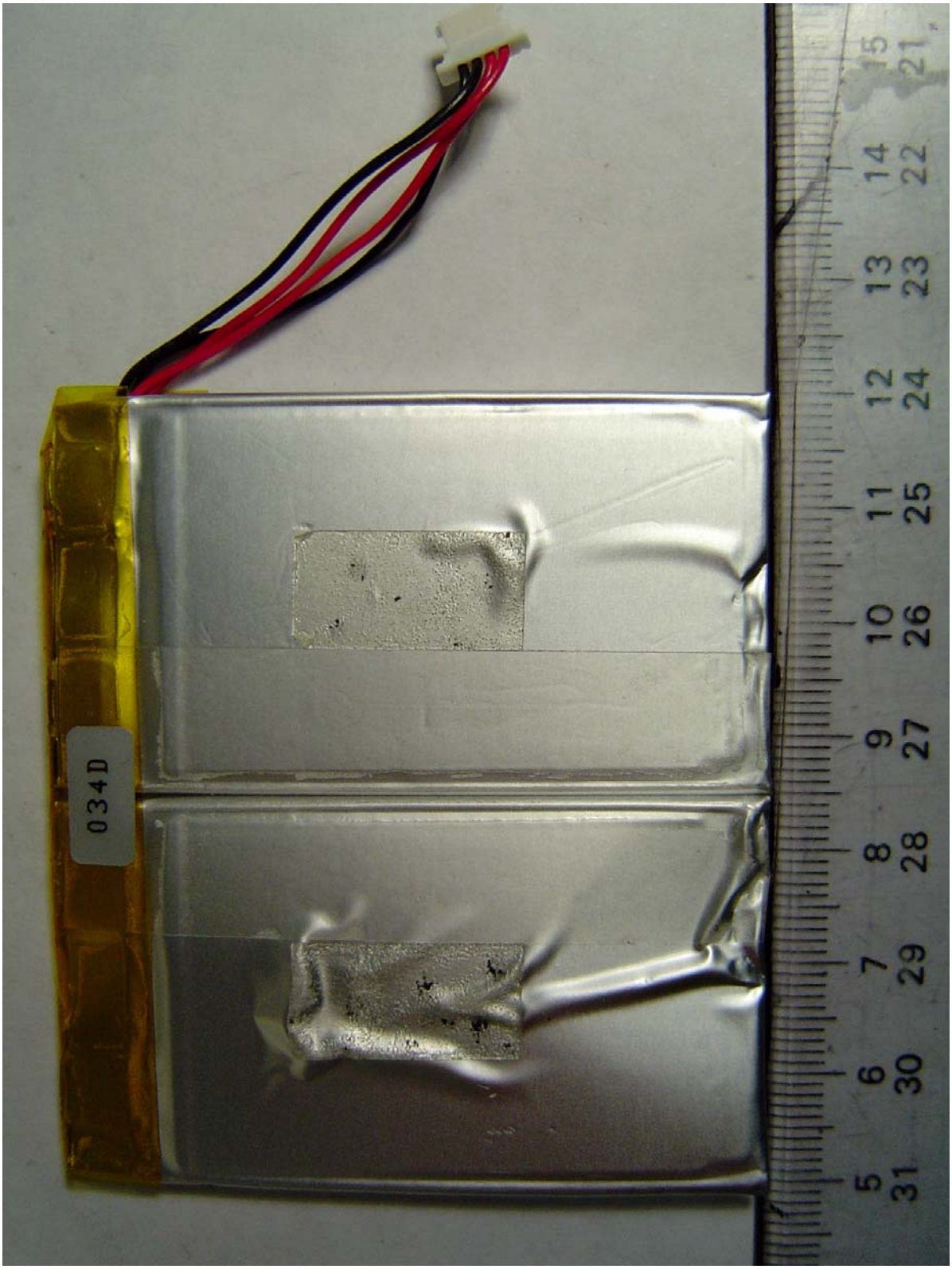
EUT Rear View (Rear Cover and Battery Removed)

EUT PHOTOGRAPHS



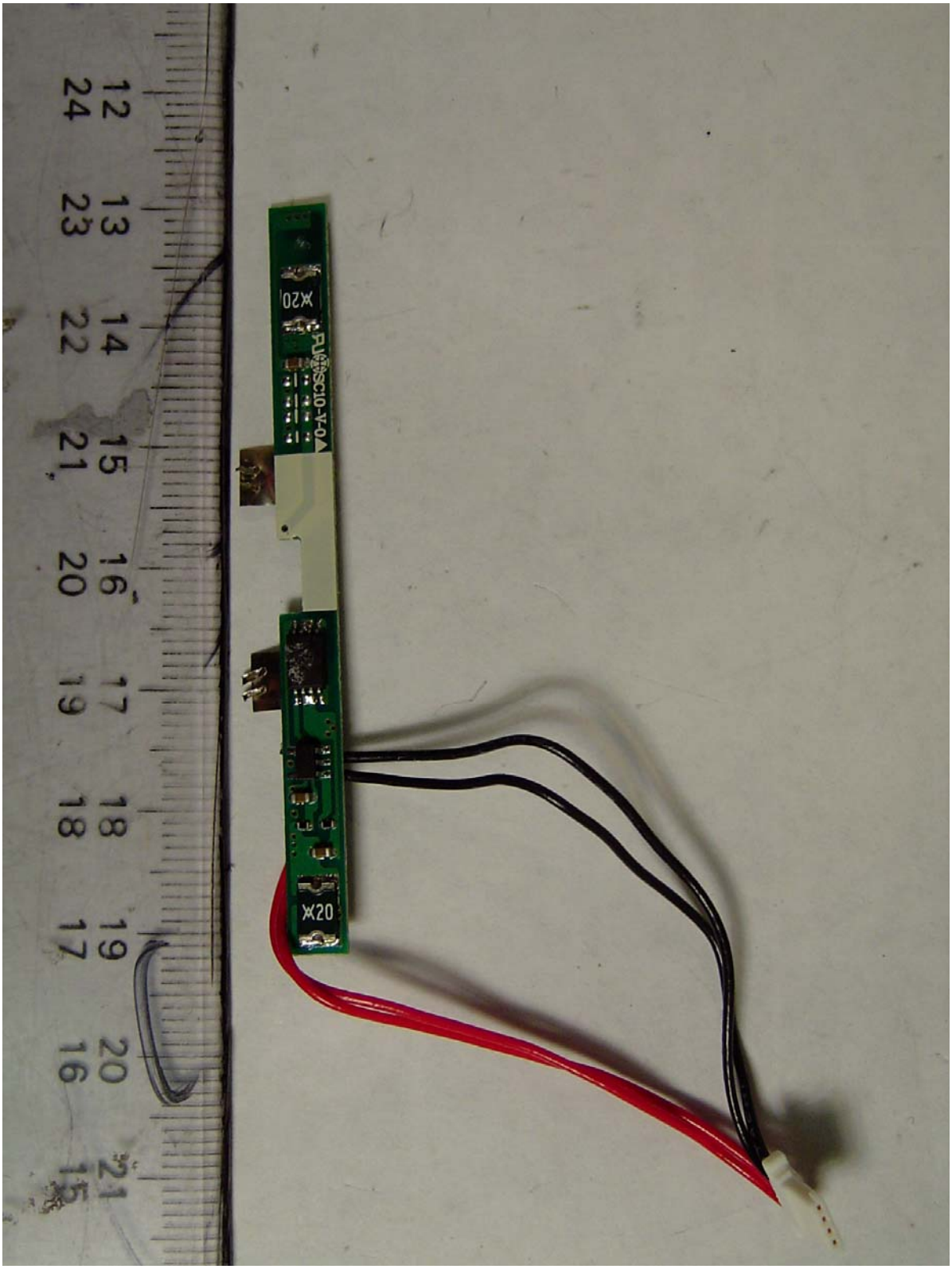
EUT Battery Front View

EUT PHOTOGRAPHS



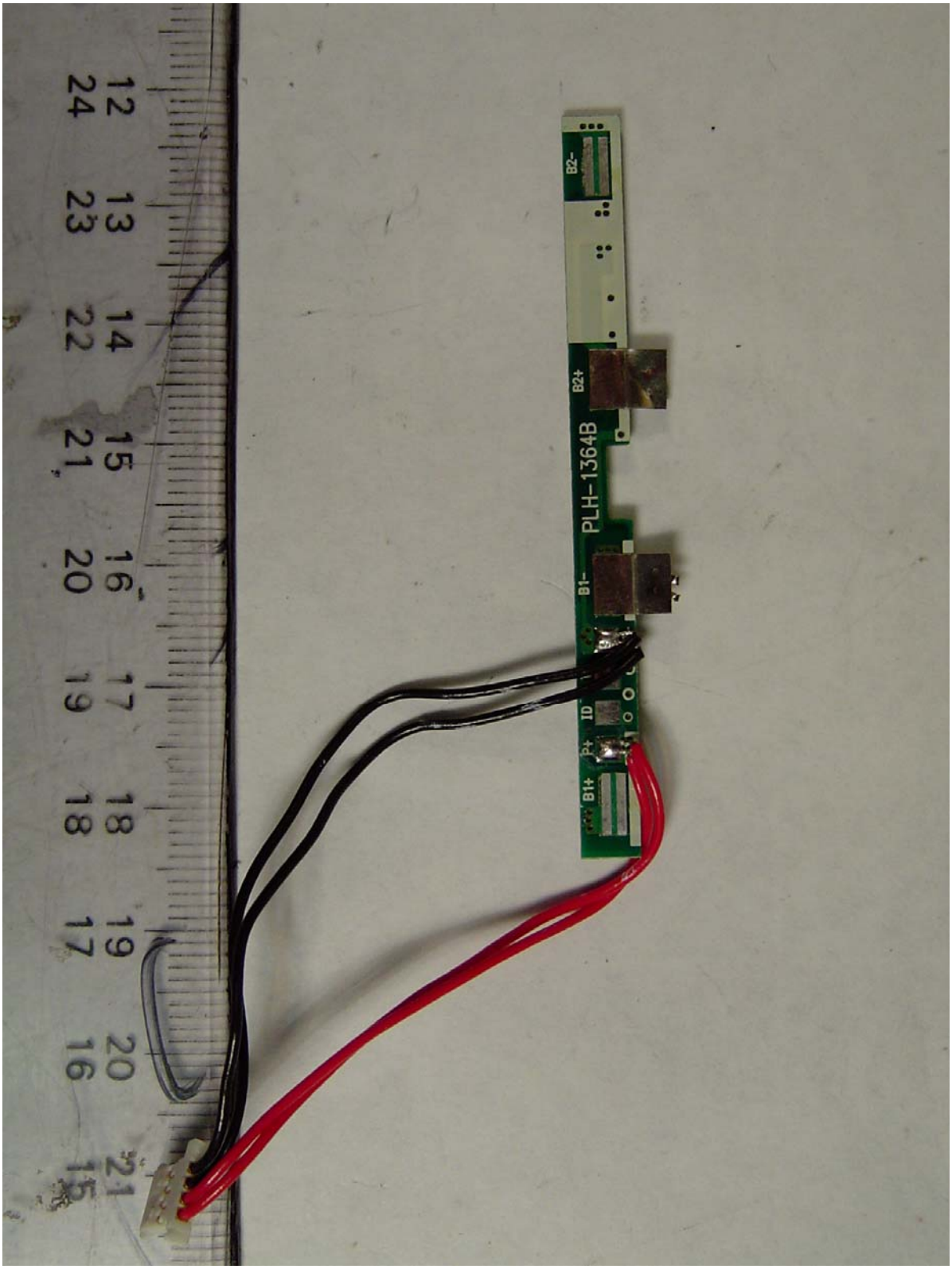
EUT Battery Rear View

EUT PHOTOGRAPHS



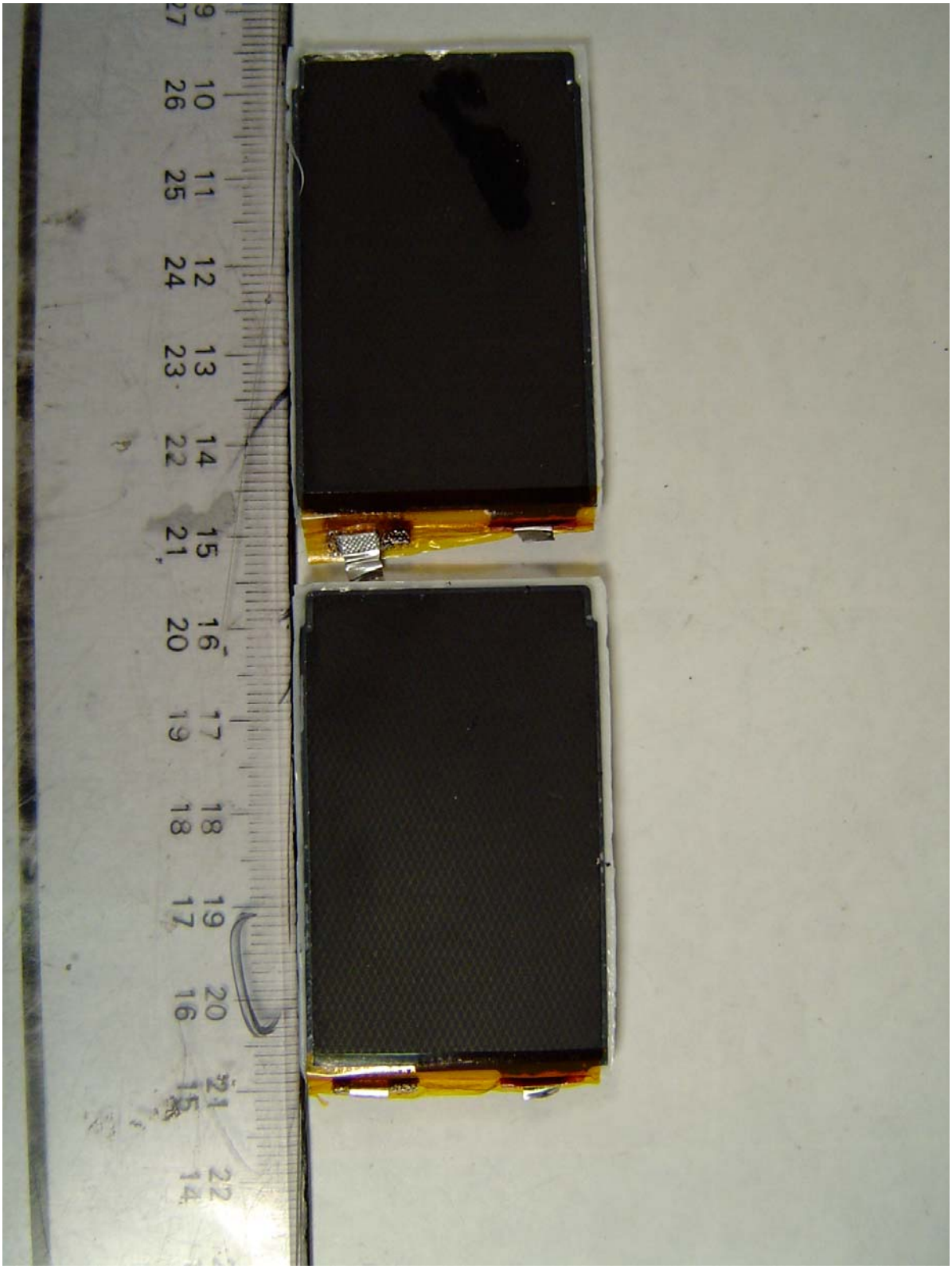
EUT Battery Circuit Component View

EUT PHOTOGRAPHS



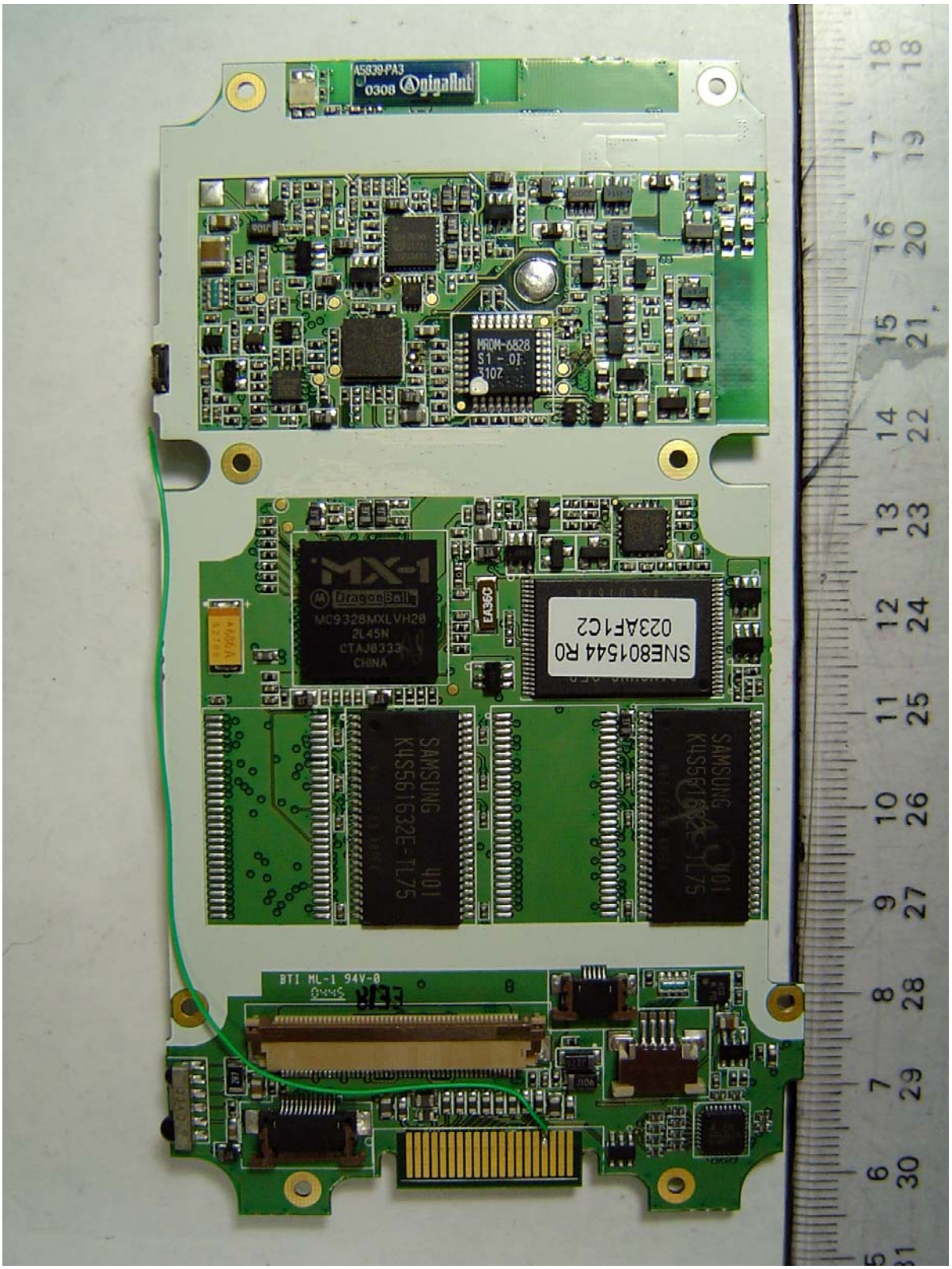
EUT Battery Circuit Trace View

EUT PHOTOGRAPHS



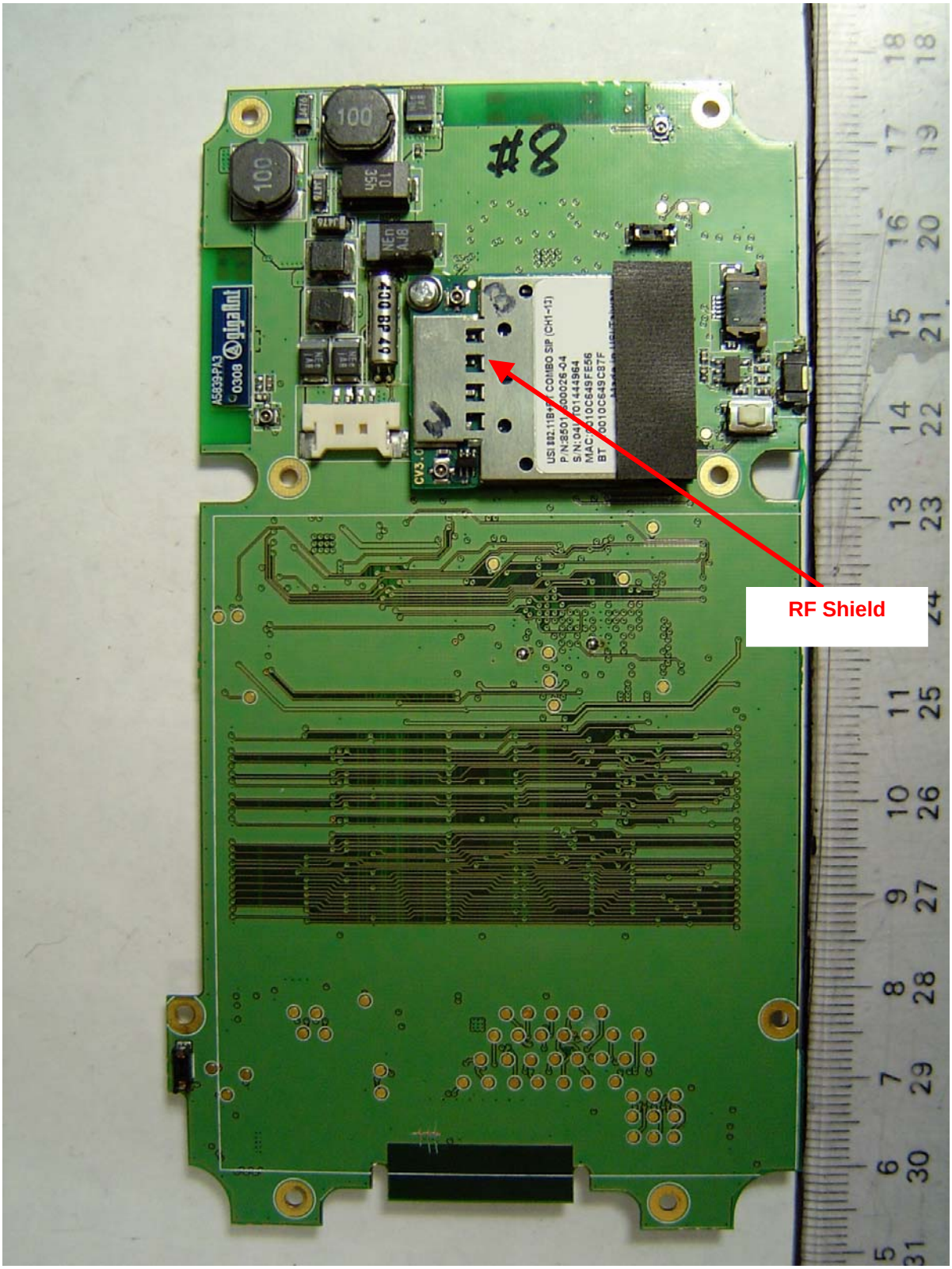
EUT Battery (With Cover Opened)

EUT PHOTOGRAPHS



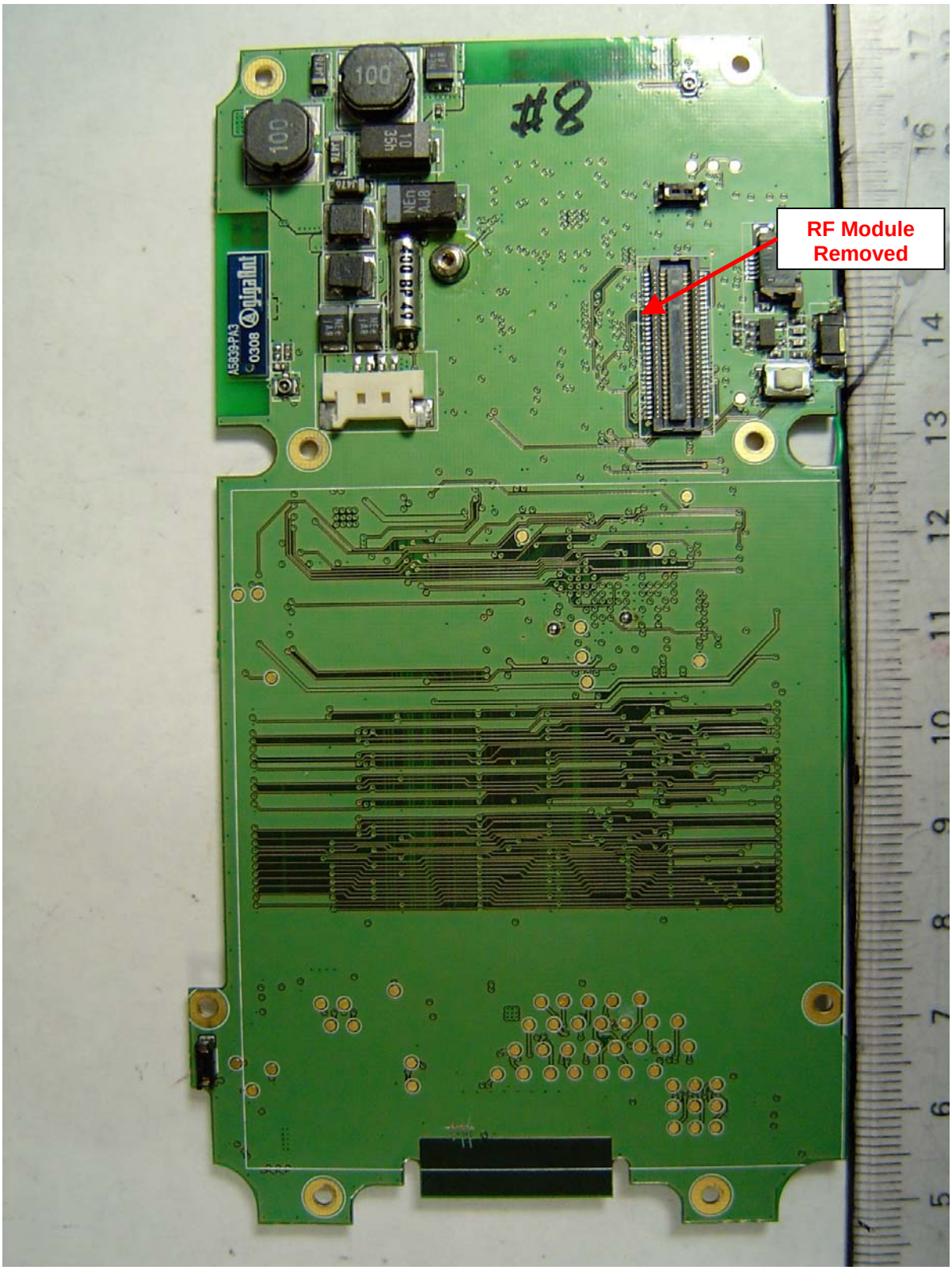
EUT Main PCB Component View

EUT PHOTOGRAPHS



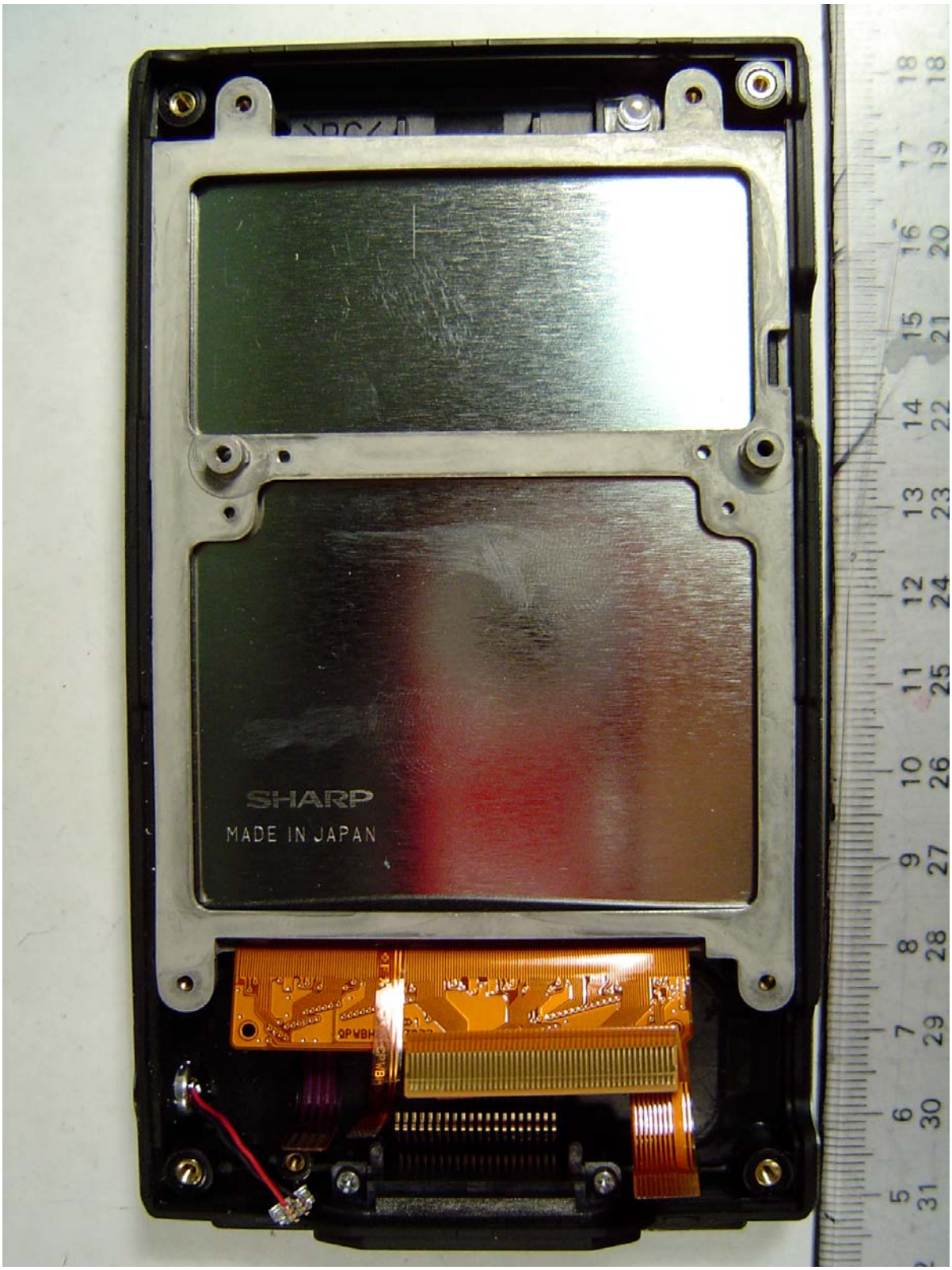
EUT Main PCB Trace View (With RF Shield Attached Battery Removed)

EUT PHOTOGRAPHS



EUT Main PCB Trace View (With Battery And RF Module Removed)

EUT PHOTOGRAPHS

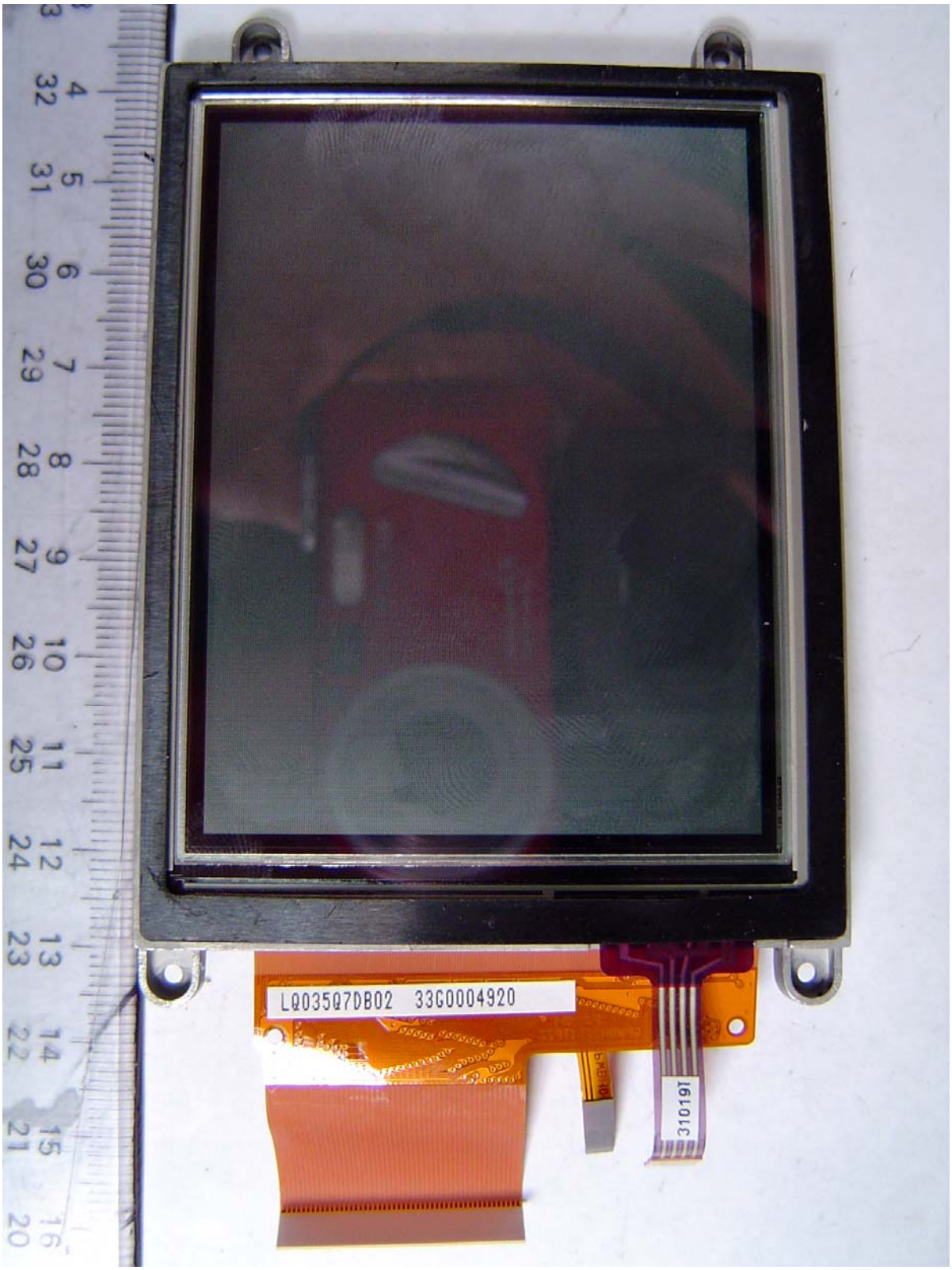


EUT Front Housing Internal View

EUT PHOTOGRAPHS

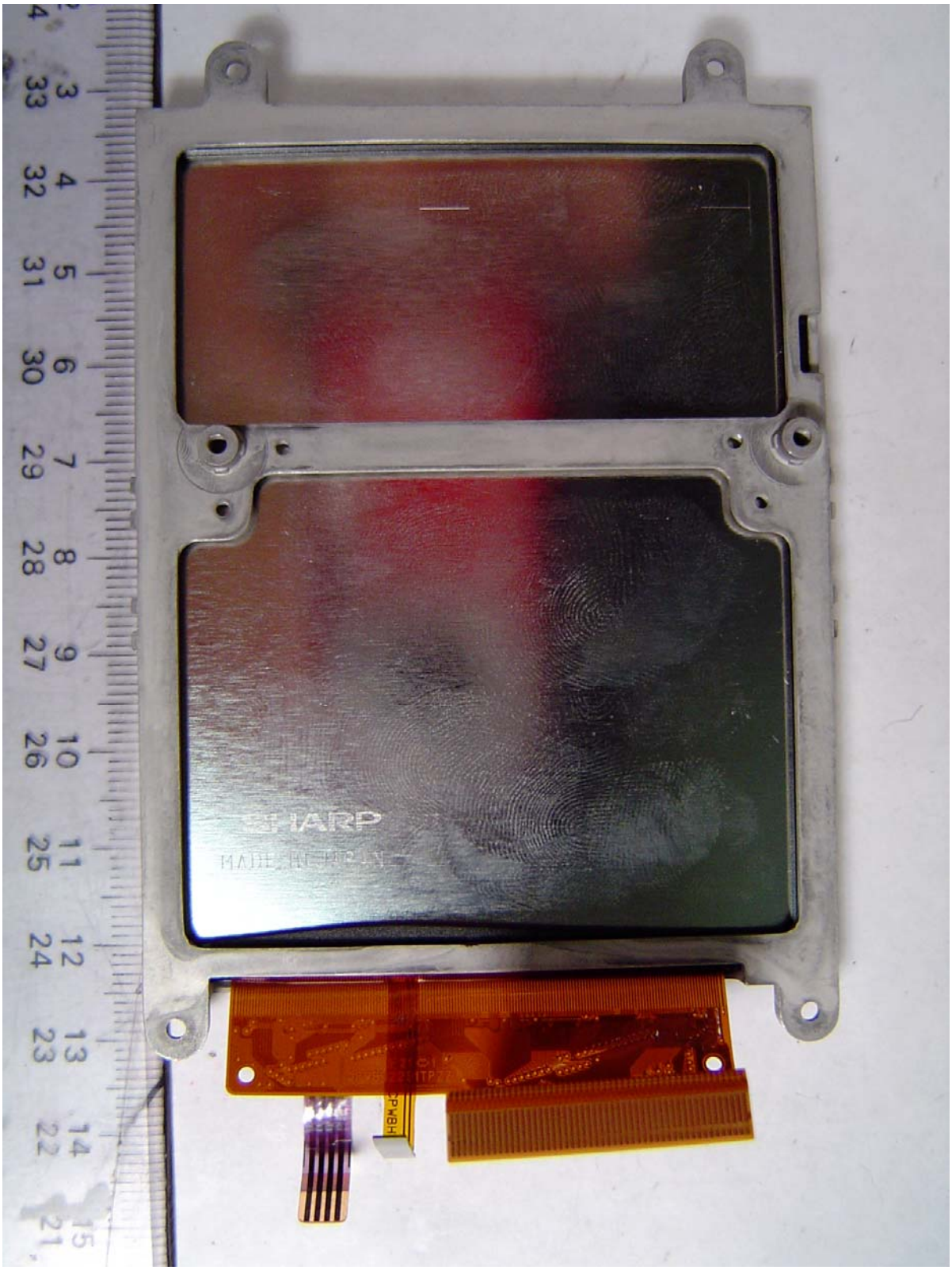
EUT Front Housing Internal View (With Display Removed)

EUT PHOTOGRAPHS



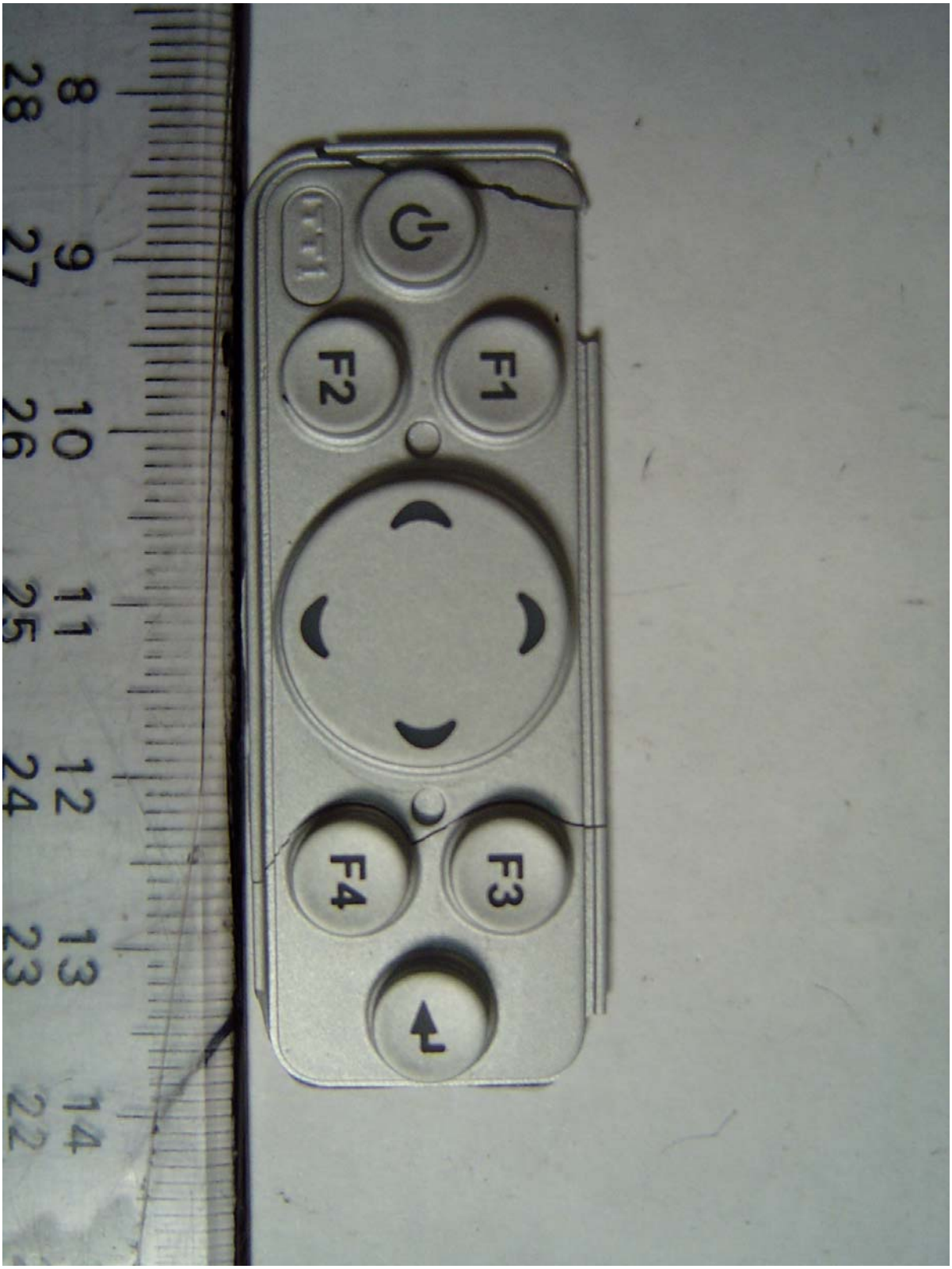
EUT Display Module – Front View

EUT PHOTOGRAPHS



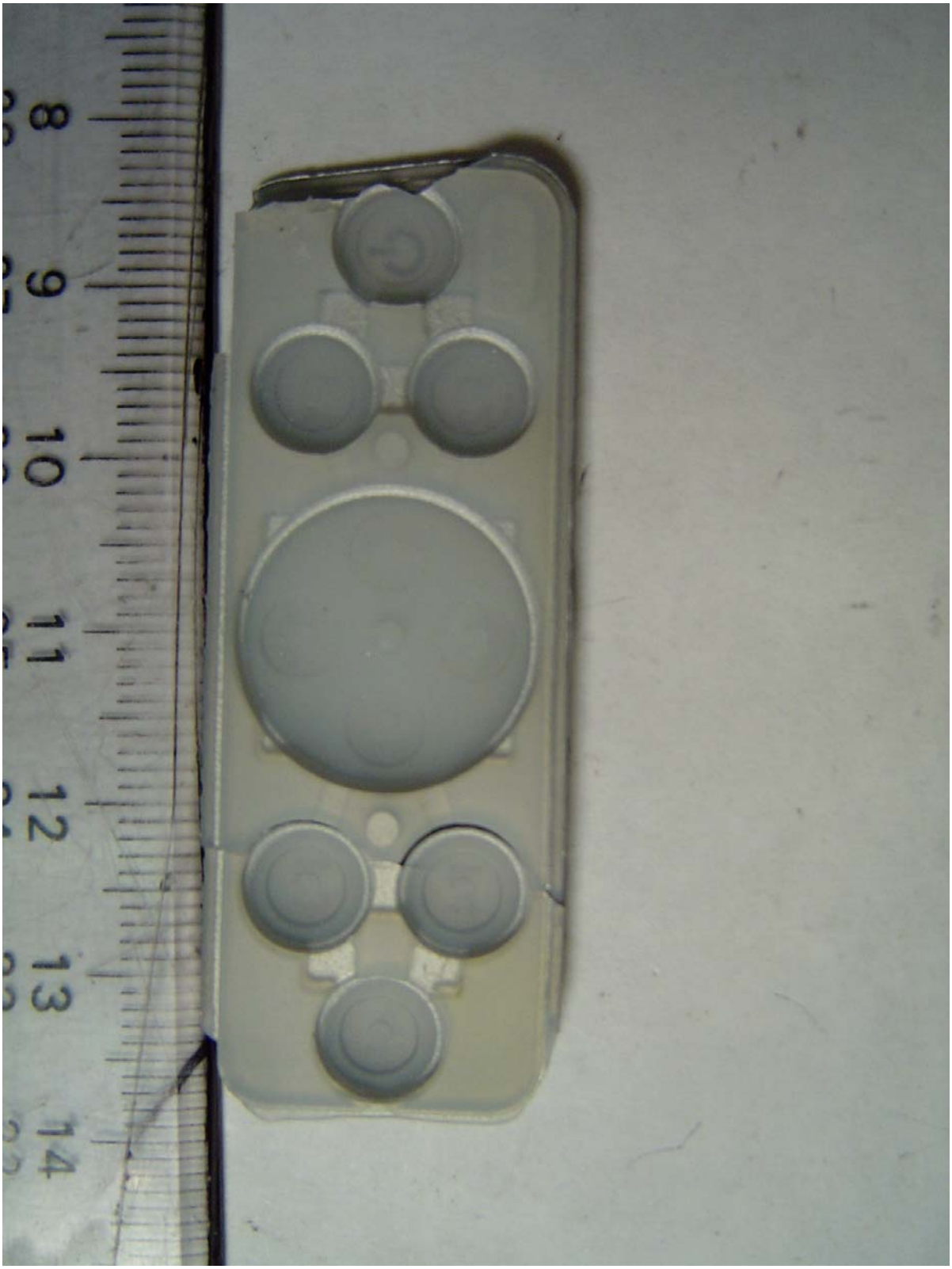
EUT Display Module – Rear View

EUT PHOTOGRAPHS



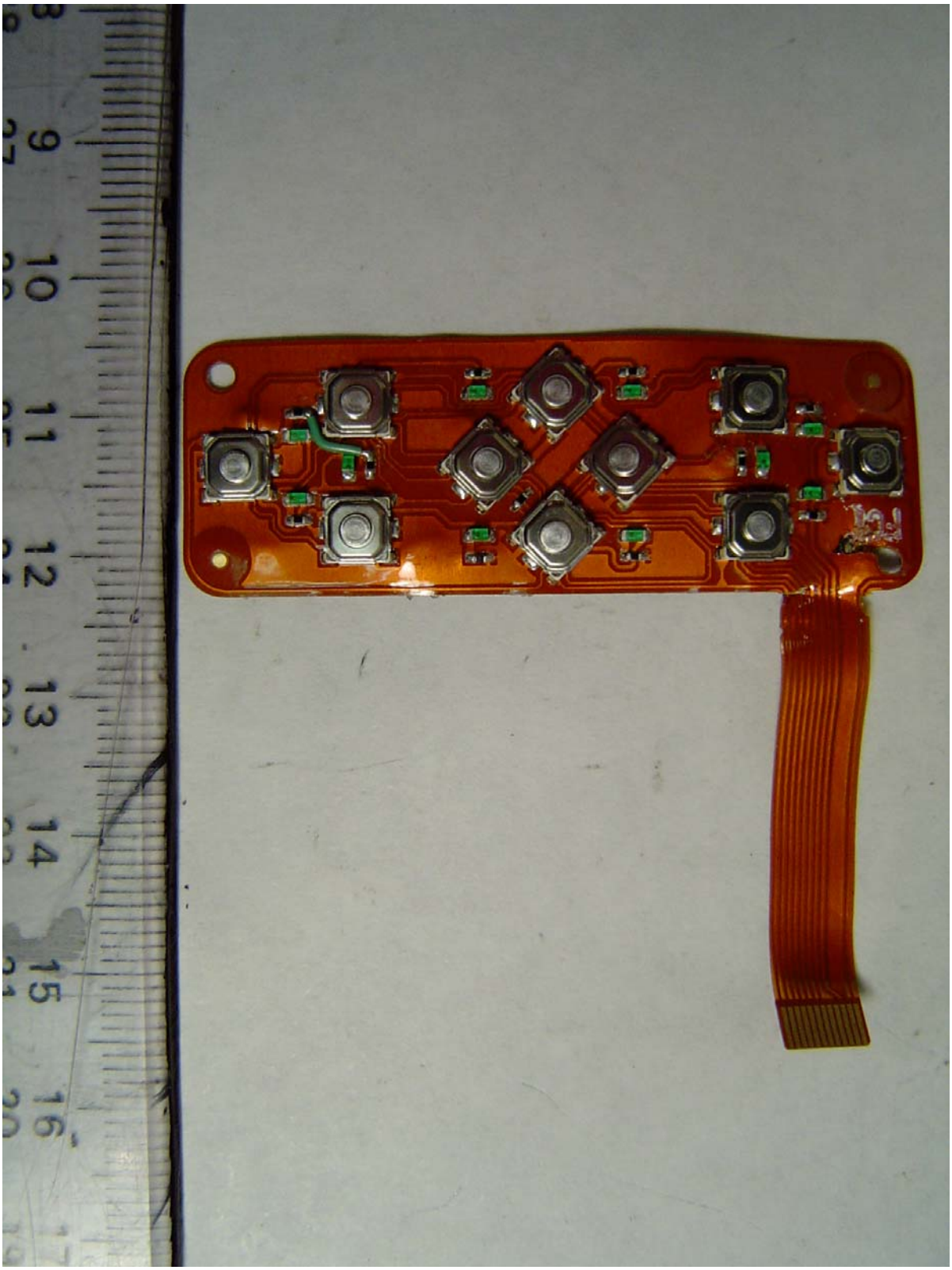
EUT Keypad – Front View

EUT PHOTOGRAPHS



EUT Keypad – Rear View

EUT PHOTOGRAPHS

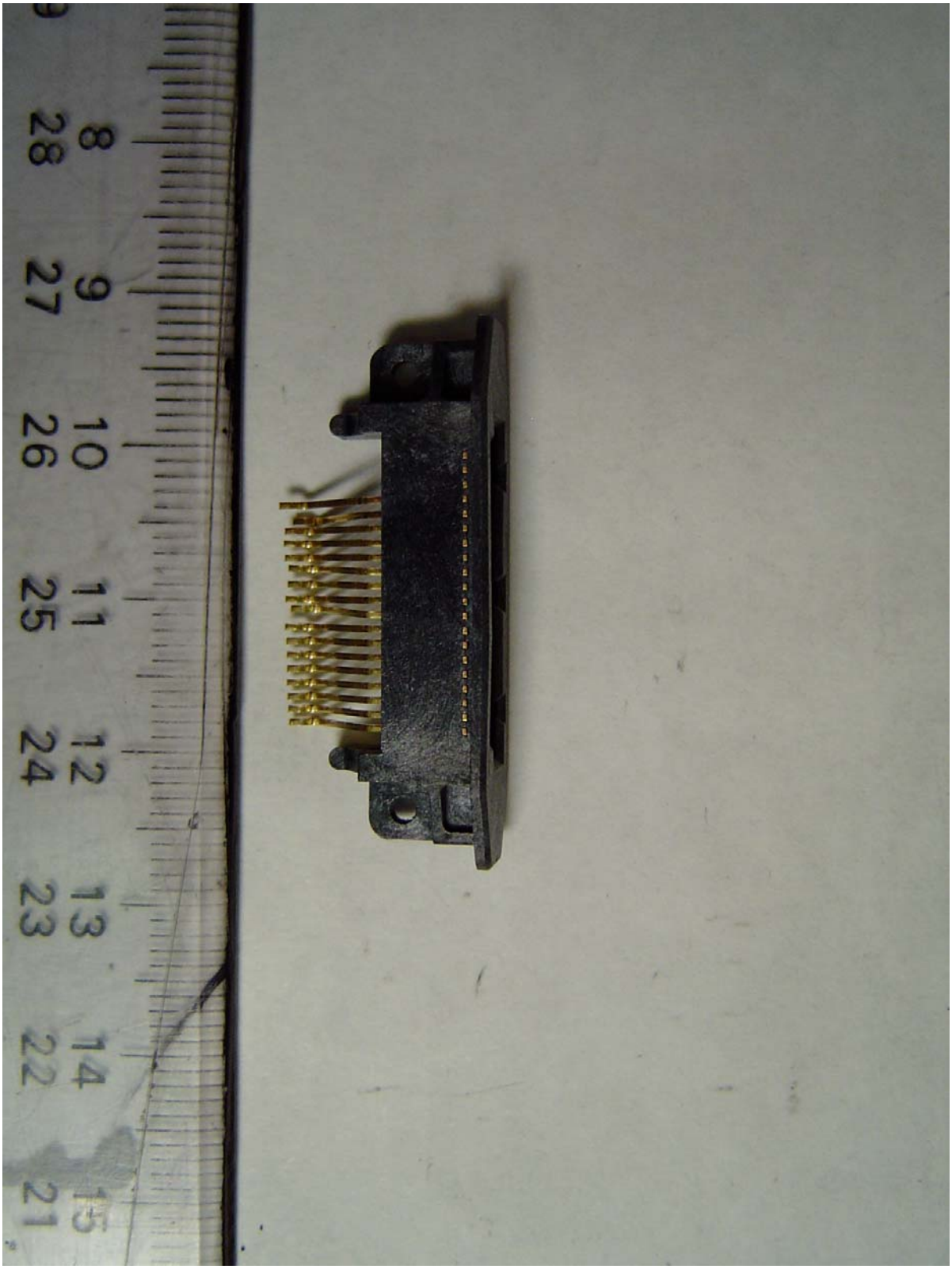


EUT Keypad Flexible Circuit – Front View

EUT PHOTOGRAPHS

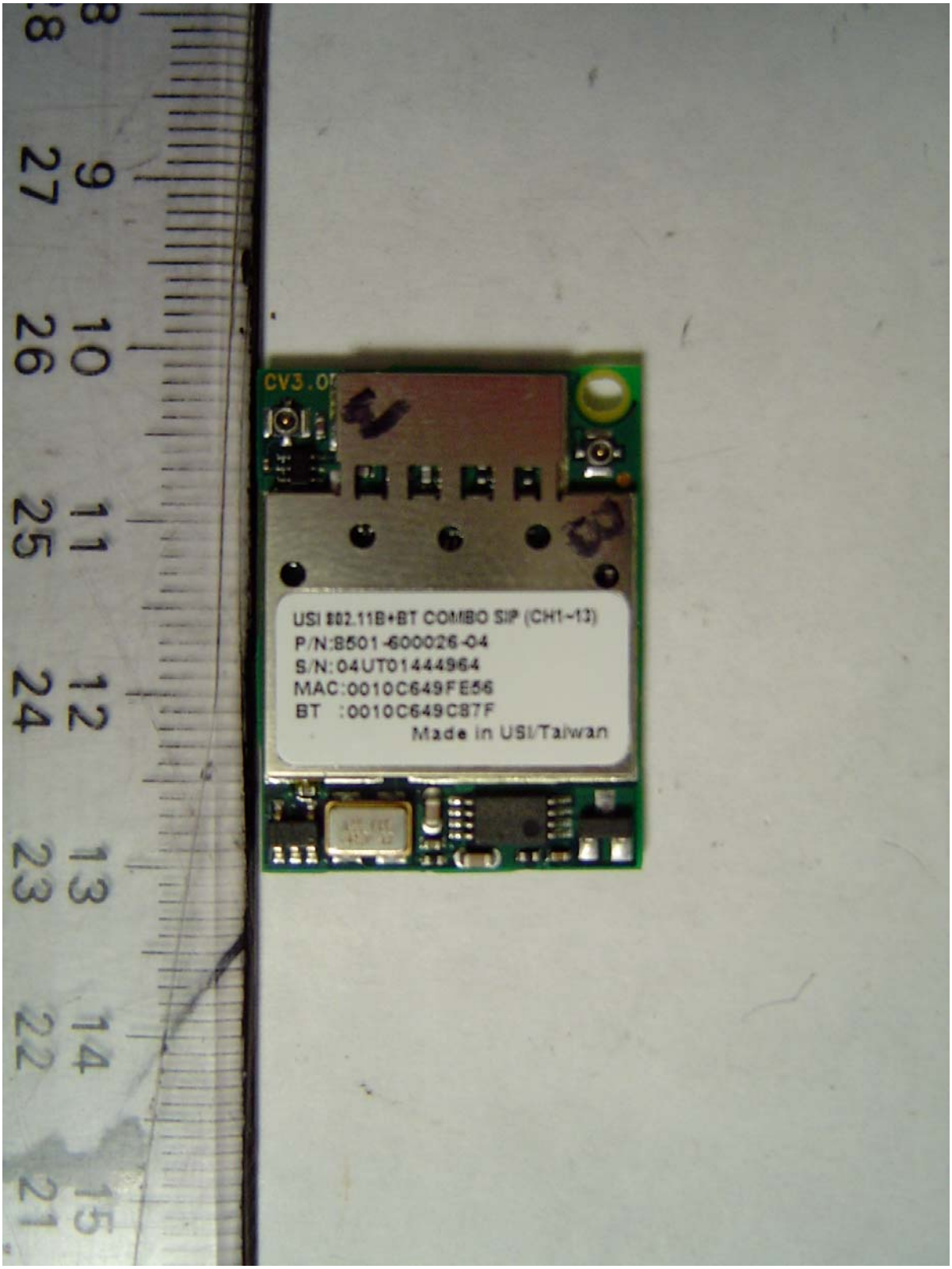
EUT Keypad Flexible Circuit – Rear View

EUT PHOTOGRAPHS



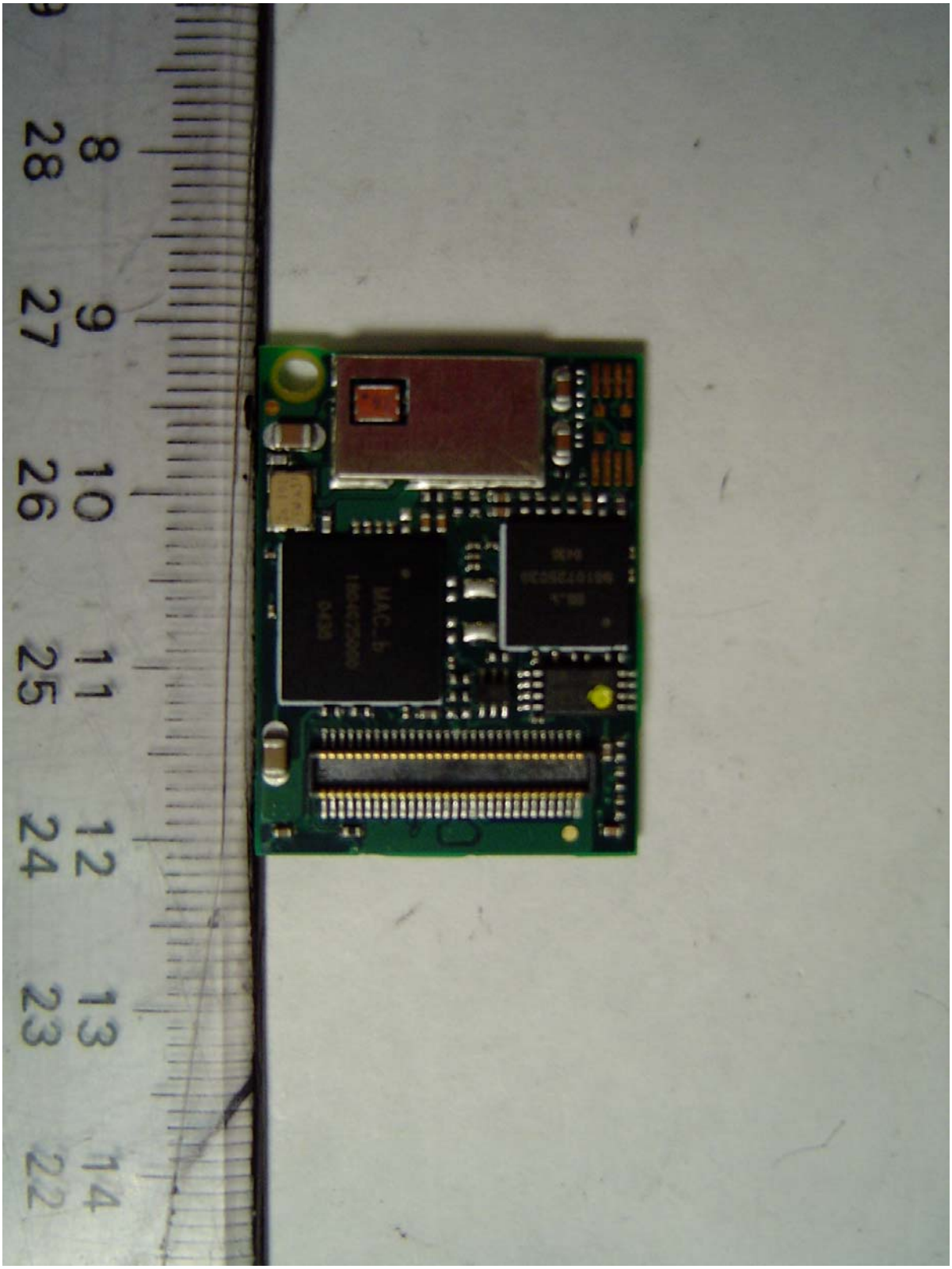
EUT Cradle Port Connector – Top View

EUT PHOTOGRAPHS



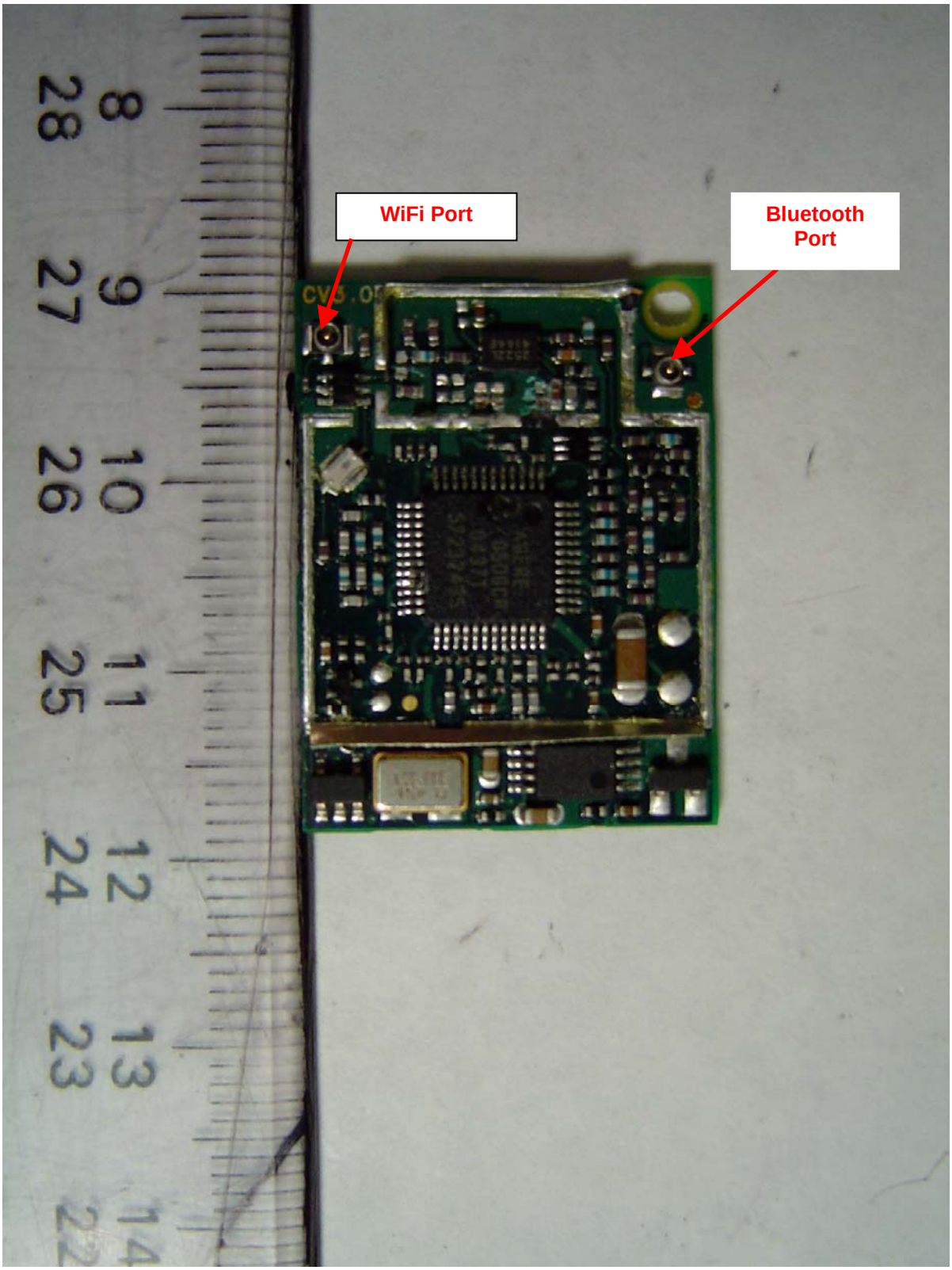
EUT RF Module Overall Component View

EUT PHOTOGRAPHS



EUT RF Module Overall Trace View

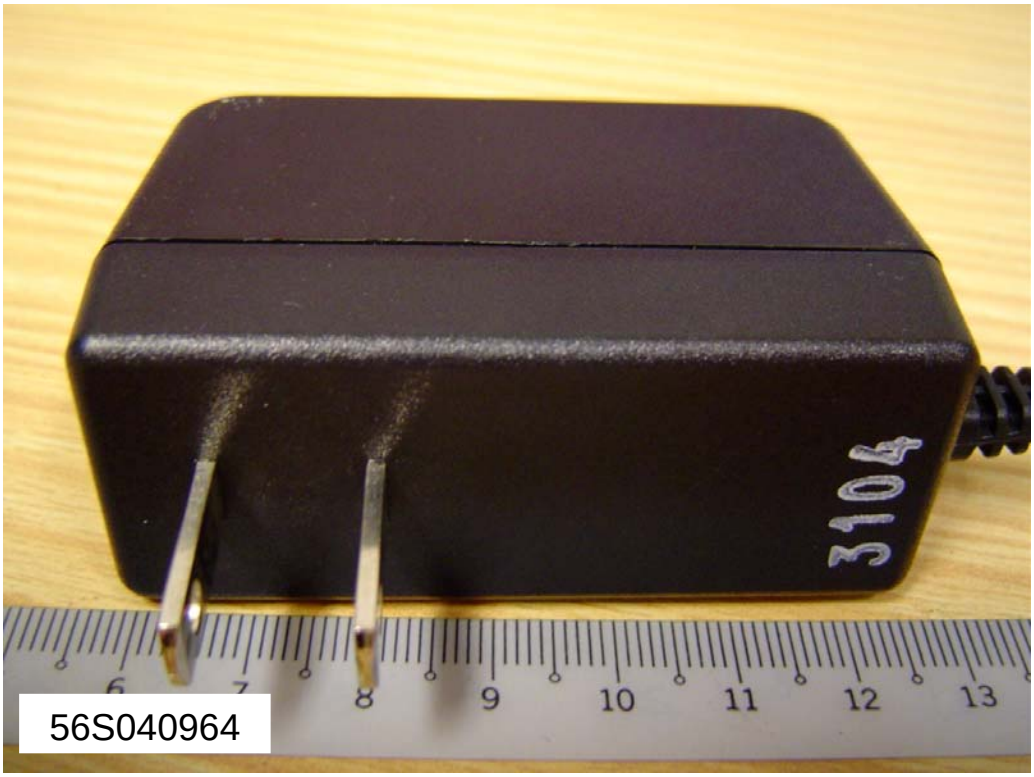
EUT PHOTOGRAPHS



EUT RF Module Overall Component View (With Shield Removed)

EUT PHOTOGRAPHS

EUT Adapter (Front View)



EUT Adapter (Rear View)

ANNEX C

USER MANUAL
TECHNICAL DESCRIPTION
BLOCK & CIRCUIT DIAGRAMS

(Please refer to attached copy)

ANNEX D

FCC LABEL & POSITION

Labelling requirements per Section 2.925 & 15.19

The label shown will be permanently affixed at a conspicuous location on the device and be readily visible to the user at the time of purchase.

Physical Location of FCC Label and ID on EUT

FCC LABEL & POSITION ANNEX D

Labelling requirements per Section 2.925 & 15.19

The label shown will be permanently affixed at a conspicuous location on the device and be readily visible to the user at the time of purchase.

FCC And ID Logo Sample Label